DECEMBER 1954

PRECISION METAL MOLDING

INCLUDING DIE CASTINGS MAGAZINE

DIE CASTINGS
INVESTMENT CASTINGS
POWDER METALLURGY
PERMANENT MOLD CASTINGS
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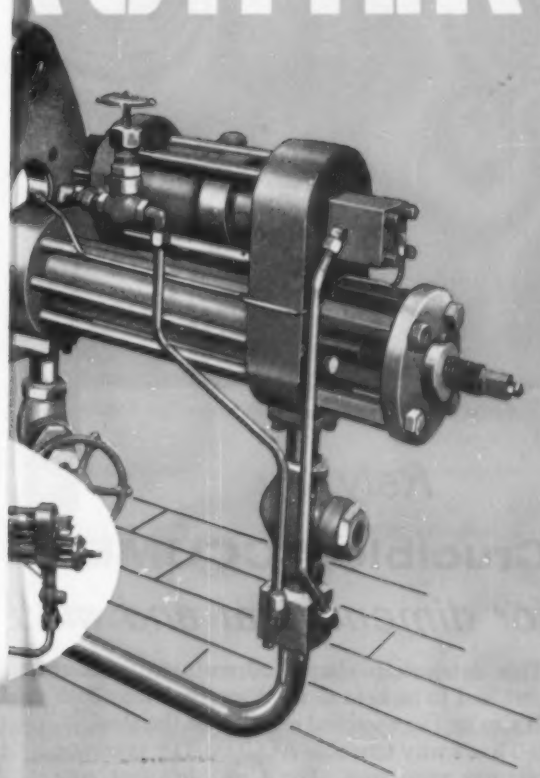

You Can Always Depend on a CAST-MASTER to Produce Castings with finer molecular structure ... better surface finish!

IN ADDITION to its many other efficiency features, CAST-MASTER now offers, as optional equipment, a new Shot Pressure Intensifier. This new Intensifier is engineered to operate without the use of time-consuming valves, permitting a simultaneous build up from the normal line pressure to intensified pressure without hesitation. The use of the new intensifier results in less porosity, producing castings with a mirror-smooth finish.

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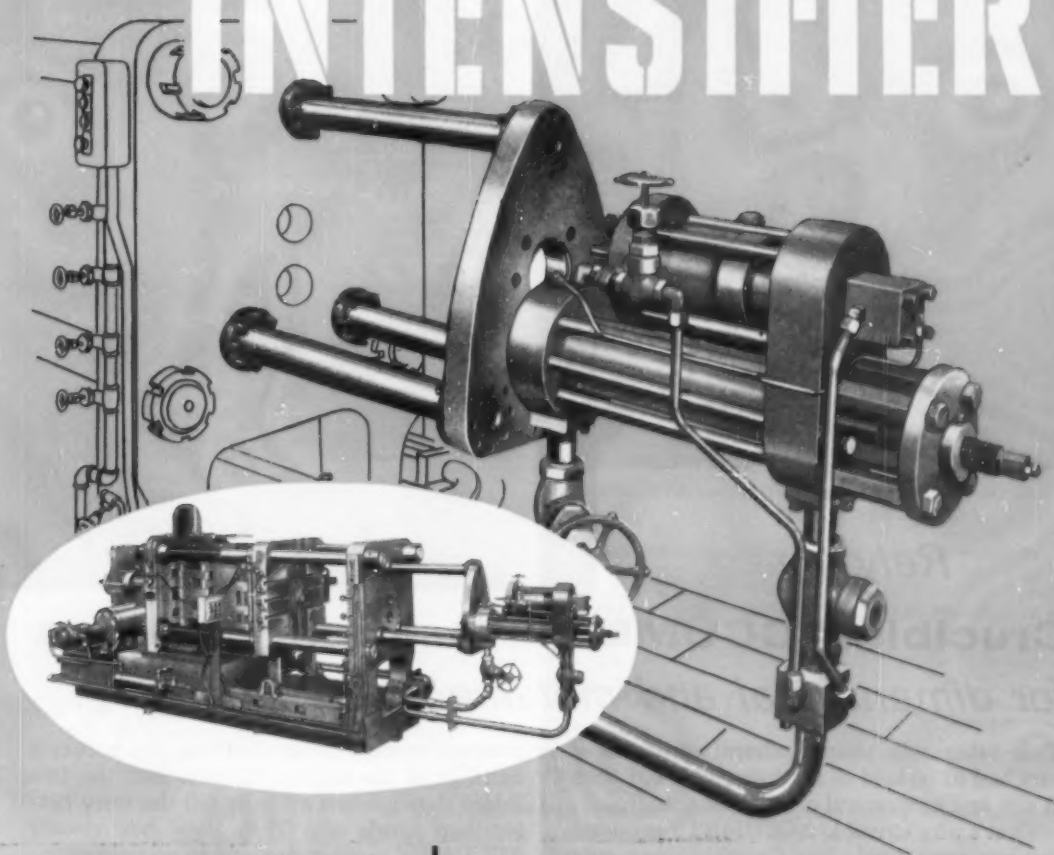

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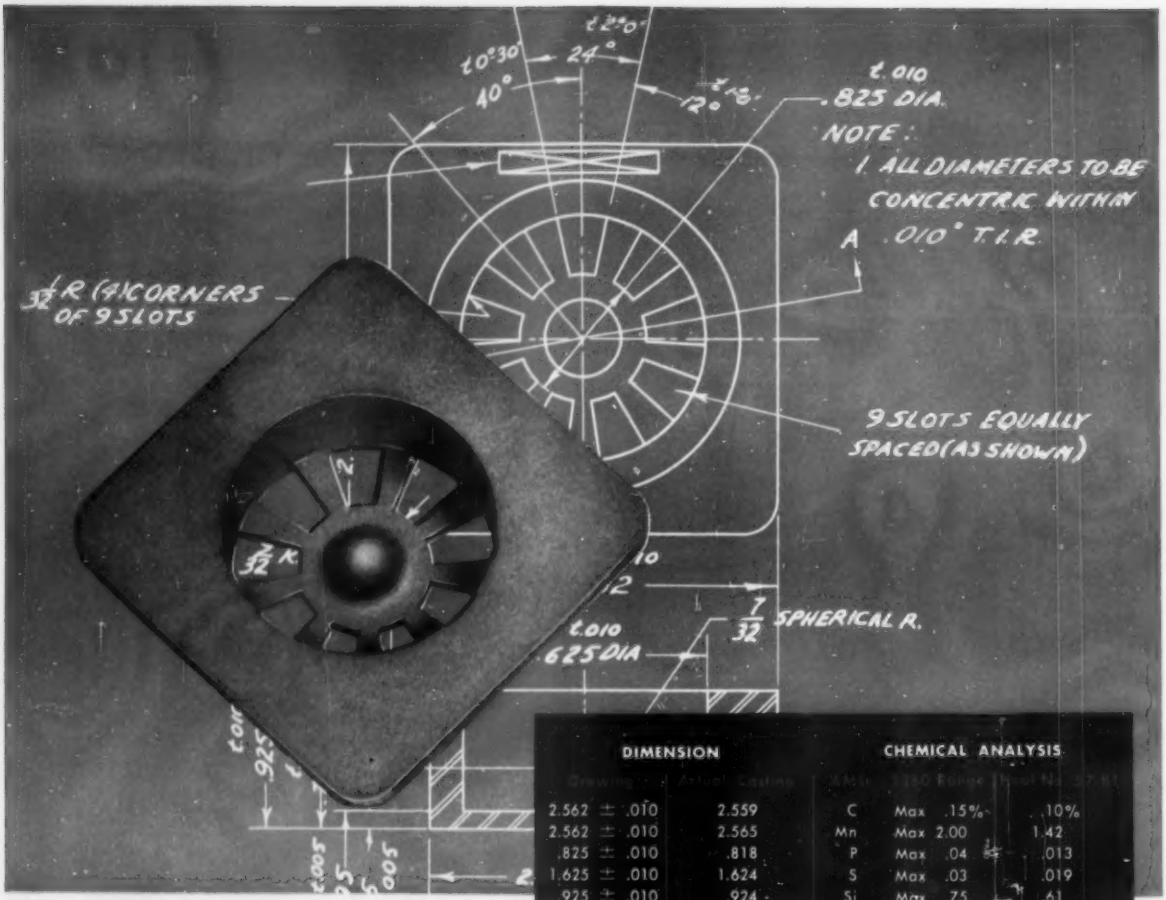

DIMENSION		CHEMICAL ANALYSIS		
2.562 ± .010	2.559	C	Max .15%	.10%
2.562 ± .010	2.565	Mn	Max 2.00	1.42
.825 ± .010	.818	P	Max .04	.013
1.625 ± .010	1.624	S	Max .03	.019
.925 ± .010	.924	Si	Max .75	.61
.700 ± .010	.698	Ni	12.00-14.00	13.00
.105 ± .005	.109	Cr	16.00-18.00	17.70
2.050 ± .010	2.058	Cu	Max .50	.07
.295 ± .005	.293	Mo	1.50-2.25	1.96

Rely on

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for dimensional and metallurgical accuracy . . .

This intricately shaped aircraft instrument part had to be held to rigid specifications both in size and in chemical analysis of the steel.

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The next time you have a job where quality and close tolerances are needed, be sure to investigate the advantages of ACCUMET precision castings – *call Crucible.*

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first name in special purpose steels

54 years of Fine steelmaking **ACCUMET INVESTMENT CASTINGS**

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DECEMBER, 1954
Volume 12 Number 12

PRECISION METAL MOLDING

DIE CASTINGS • INVESTMENT CASTINGS • PLASTER MOLD CASTINGS
PERMANENT MOLD CASTINGS • POWDER METALLURGY • SHELL MOLDINGS

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FEATURE ARTICLES

35 FINAL ASSEMBLY IN SECONDS with three die castings and five screws.

36 TITANIUM MELTING AND CASTING, method and equipment for casting precision shapes.

38 RAW MATERIAL IN A "BAG" can relieve inventory problems of special bar stock.

40 PREMIUM MATERIAL AT LOWER COST, a beryllium copper investment casting for a complex shape.

41 INFILTRATION WITH COPPER gives added physical properties to powdered iron cams and gears.

45 HEAVY MACHINING CALLS FOR SOUND SECTIONS, a permanent mold casting for a military job.

47 HOW WEIGHT REDUCTION EQUALS COST REDUCTION, with savings in machining time and elimination of scrap loss.

49 WHY A DIE CAST WHEEL? An ancient device gets an up-to-date production method.

50 THE DIE CASTING PROCESS—one of a series giving basic information for designers and buyers.

85 FIRE RESISTANT HYDRAULIC FLUIDS FOR DIE CASTING—Part I, Aqueous-Base.

FINISHING SECTION

59 SEAL-PROTECT-ENHANCE WITH ONE COATING, description of the application of a vinyl plastic coating.

63 METHODS OF PLATING ALUMINUM DIE CASTINGS, a detailed outline of steps in the process.

REGULAR DEPARTMENTS

5 Letters to the Editor
16 Reference Data
23 Between the Lines
27 Books
30 Changes in Personnel
67 Product Facts
72 New Products
79 Industry News
82 Opportunities

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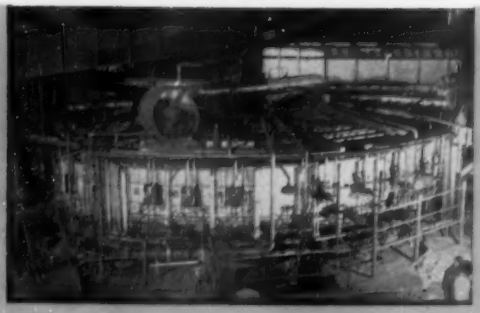
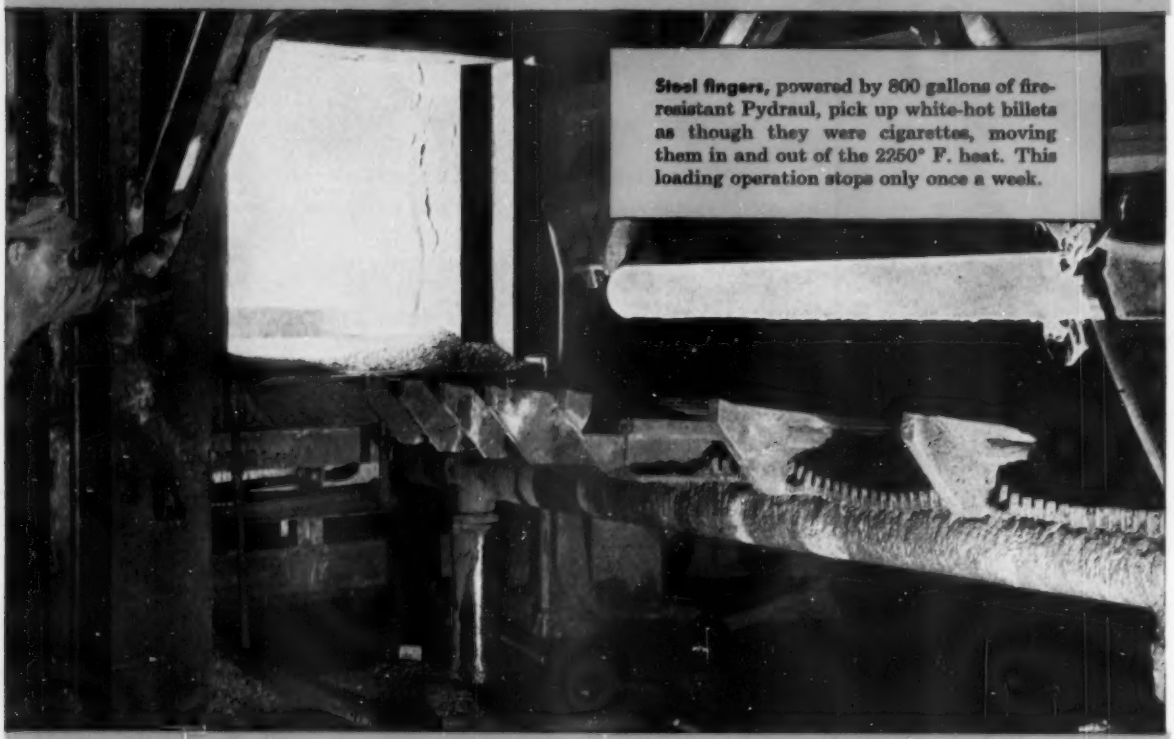


One line break with flammable fluid, causing a costly shutdown, moved Spang-Chalfant to switch to Monsanto Pydraul. Long-lasting and noncorrosive, Pydraul reduces make-up rates by as much as 80%.



Steel fingers, powered by 800 gallons of fire-resistant Pydraul, pick up white-hot billets as though they were cigarettes, moving them in and out of the 2250° F. heat. This loading operation stops only once a week.

PYDRAUL STOPS FIRES BEFORE THEY START

Monsanto Hydraulic Fluid Helps Steel Furnace Operate 160 Hours a Week

OPERATING CONTINUOUSLY to keep up with production schedules, this Hagan Rotary furnace at the Spang-Chalfant plant of The National Supply Company is equipped with a hydraulic loading boom actuated by fire-resistant Pydraul F-9.

BEFORE PYDRAUL F-9 was adopted, a line containing flammable fluid broke—shutting the furnace down for six hours. In addition to damage to electrical connections, the downtime was expensive in terms of lost production.

AFTER PYDRAUL WAS INTRODUCED, one incident demonstrated dramatically its fire-resistant properties. A ruptured hose connection sprayed Pydraul over hot billets and into the furnace door. This time, however, there was no damage to equipment or injury to personnel. Only a minimum of production time was lost while the hydraulic system was refilled.

Pydraul: Reg. U. S. Pat. Off.

Ask us for this booklet on Pydraul. Write Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478, St. Louis 1, Missouri.

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Letters to the editor

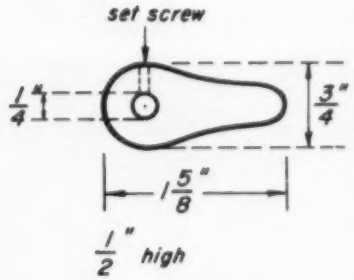
SOURCES . . .

We are looking for a concern that manufactures dials, pointer knobs, etc. We prefer a pointer knob in Zinc that we could have chrome plated.

We prefer a concern that carries these knobs as standard equipment to eliminate the costs of die charge, if at all possible.

We now use a Plastic knob which we buy from a firm that carries a line of knobs. I am hoping to find the same in the die cast field.

I will give you a general idea as to what this knob looks like on the bottom of the page. (See drawing.—Ed.) Hoping you can refer me to someone I can write as I am in a rush for prices on this item. — L.B.S. (Purchasing Agent)



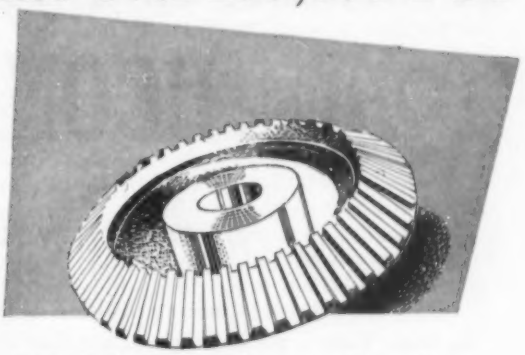
Do you have available in your files, the name of a die cast concern who has stock molds for molding knobs and handles. If so, we would appreciate you forwarding same to us in order that we may write them direct.

We would like to use a stock item, that is stock with someone else, if possible, without having a special die made up. — S.P.S.

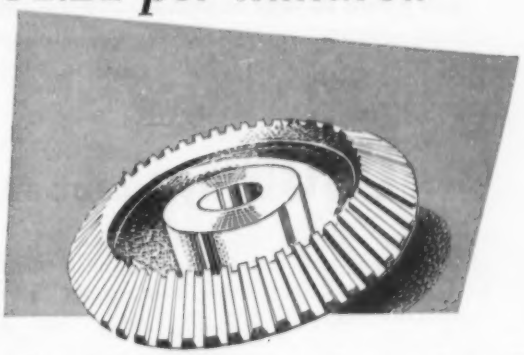
We are having trouble obtaining shell mold castings of the desired surface smoothness for use on research instruments.

Continued on page 7

With Tensiles Over 100,000 PSI



one costs $31.21 *per hundred*



and one costs $22.51 *per hundred*

Why?

With reduced iron powders in both cases . . . the expensive compact derives its physicals from copper infiltration; the inexpensive compact from small additions of Metal Hydrides' chromium-nickel pre-alloyed powders. The comparative facts below show how you can achieve the physicals you need . . . in less than half the steps . . . at impressively lower cost with the MH process.

Copper Infiltration	MH Chrome-Nickel*
Cost — $31.21 per 100	Cost — $22.51 per 100
Tensile — 112,000 PSI	Tensile — 103,000 PSI
Elongation — 1%	Elongation — 2.5%
Rockwell Hardness — C34	Rockwell Hardness — B100
Apparent Density — 7.78	Apparent Density — 6.83
Production Steps — Nine	Production Steps — Four

**(7½% addition of 50% chrome/ 50% nickel, plus 1% carbon)*

Without obligation our technical sales staff will gladly give you complete information and show you how chromium-nickel pre-alloyed powders will meet your requirements. Write today!

Pioneers In Hydrogen Compounds

MH **Metal Hydrides** INCORPORATED

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Hydraulic Engineers agree...

it's UCON hydrolubes FOR SAFETY

Trade-Mark

here's why...

UCON hydrolubes are CARBIDE'S water-base hydraulic fluids. Water is the key to non-flammability.

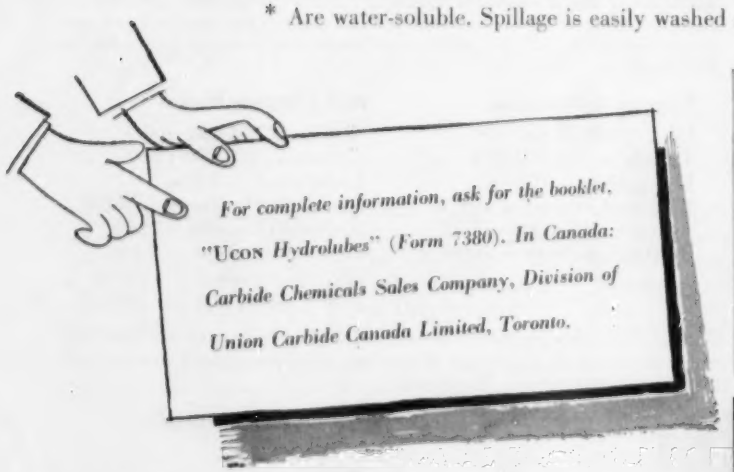
Resistance of UCON hydrolubes to burning has been proved by years of severe, exhaustive testing in the laboratory. And, in *actual service*, UCON hydrolubes have prevented fires and serious damage during their more than 6 years of routine use.

To get this kind of protection, switch to UCON hydrolubes. Changing over is simple—drain the old fluid from your system, follow the cleaning procedure that CARBIDE recommends, and refill—no need to revamp your equipment, since . . .

UCON hydrolubes...

Trade-Mark

* Have no harmful effects on packings and seals. Leakage losses are often lower than with regular hydraulic fluids.
* Contain effective liquid- and vapor-phase corrosion inhibitors for the common metals.
* Have good lubricity. Special anti-wear agents provide satisfactory pump life and performance characteristics.
* Are made in 3 viscosity grades—200, 300, and 550 S.U.S. at 100°F. Other viscosity grades can be supplied to fit specific requirements.
* Have high viscosity indexes—150 to 160.
* Have low pour points—below minus 55°F. UCON hydrolubes flow readily at low temperatures.
* Are non-toxic for all practical hydraulic purposes.
* Are water-soluble. Spillage is easily washed away.



For complete information, ask for the booklet, "UCON Hydrolubes" (Form 7380). In Canada: Carbide Chemicals Sales Company, Division of Union Carbide Canada Limited, Toronto.

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LETTERS TO THE EDITOR
continued from page 5

Our vendor has trouble maintaining proper surface quality. Could you suggest a firm or firms equipped tp supply short runs of shell molded aluminum castings of surface quality suitable for quality instruments? — H.E.S. (Development Engineer)

In the October issue of your magazine, page 83, you show a gear belt-drive gear, made by Kwikset Locks Powdered Metal Division.

I would like to contact these people, but do not know where they are located, as I want to get a sample. Will you please advise me? — G.A.L.

Would you send me available literature on the Shell Molding process. Also a list of firms in the New York Metropolitan area who are equipped for doing production work with the shell molding process. —G. G.

We receive frequent requests for sources of various types of castings, sometimes within a certain geographical area, sometimes by type of alloy cast. We are usually able to supply this information. However, we do not have a list of die casters who have stock dies, inasmuch as this is not as commonly done in the die casting industry as in plastic molding. We do not know of any, offhand, who have stock dies for knobs or dials, although there are die casters who have stock dies for pulleys, small fasteners, pinions for toys, certain types of plumbing hardware, etc. — Ed.

TEMPERATURE RISE

I have recently had my attention drawn to your article on "The Sintering Process", published in October and November in "Precision Metal Molding", which I have read with interest.

In your theoretical discussion you state that a temperature rise between 10 and 75 degrees absolute causes the value of the diffusion coefficient to double, depending upon the system studied. I would be interested to receive literature references from you dealing with solid diffusion processes where a doubling of the diffusion coefficient takes place on raising the temperature by 10°C. — D.W.G. (England)

The article was written by Associate Editor Philip Kalischer, who comments that the source for his statement concerning the doubling of the diffusion coefficient by a temperature rise of 10 to 75 degrees absolute, was work done in the Metals Research Laboratories of the Carnegie Institute of Technology and privately communicated to him several years ago. Whether or not the work of which this is a part has been published, is not known.—Ed.

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9.5¢ per lb. Now — you can improve small metal parts quality by specifying America's premium quality sponge iron powder — ANCOR 80. Yes, you improve quality . . . yet cut costs at this low price. That's a profitable combination. Immediate delivery . . . any quantity. Write for more details. Ask for free engineering booklet.

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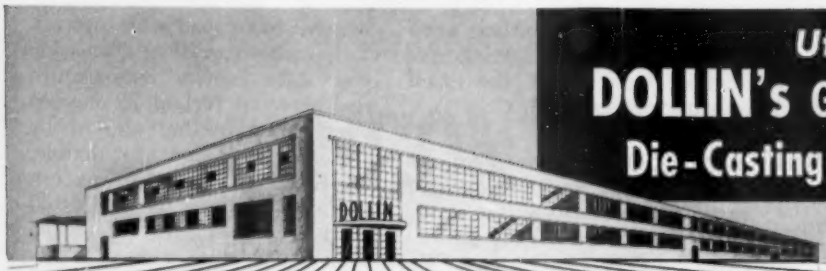

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DOLLIN's Greatly Expanded Die-Casting Facilities to...

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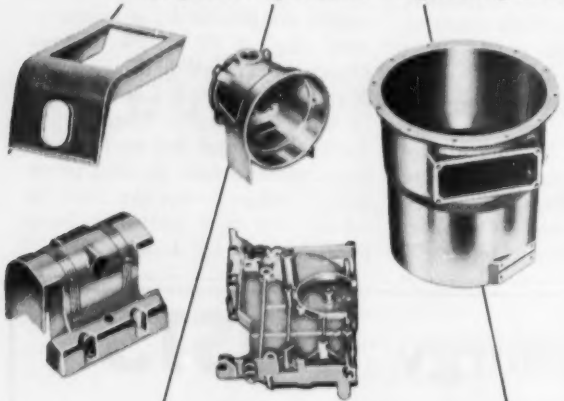
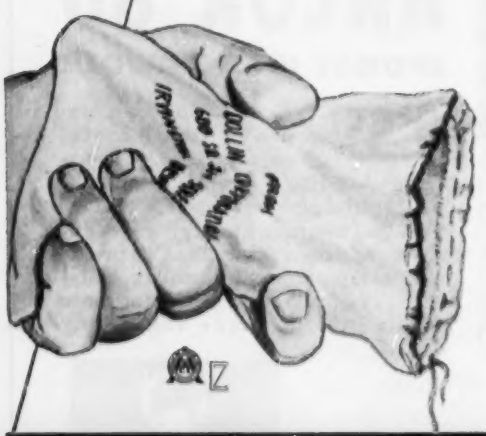
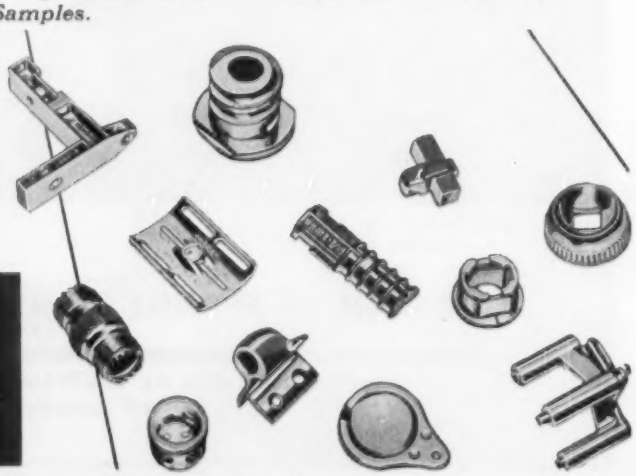
Many leading manufacturers have long depended on our specialized experience and equipment for their zinc and aluminum die-casting needs. Now all departments—aluminum castings, large zinc castings, small zinc castings—have been *doubled* in capacity *and* made more efficient. Let us show you what this can mean to you in piece-costs . . . casting quality . . . deliveries. Send prints or samples for quotation—engineering advice at no obligation.



Cut Costs of SMALL Parts ...

Would you like to buy an *assembly* instead of 2 or 3 separate small parts? Eliminate machining operations? Cut scrap loss? Perhaps you can with *low cost* small zinc die-castings (1000 per lb. to 3 per lb.) made at screw-machine, stamping press speeds on our special *fully-automatic machines*. Send prints or samples for quotation—write for *Small Parts Folder & Samples*.





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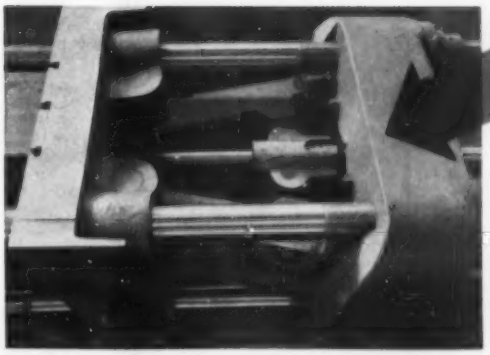
REPETITIVE PURCHASES PROVE SUPERIORITY

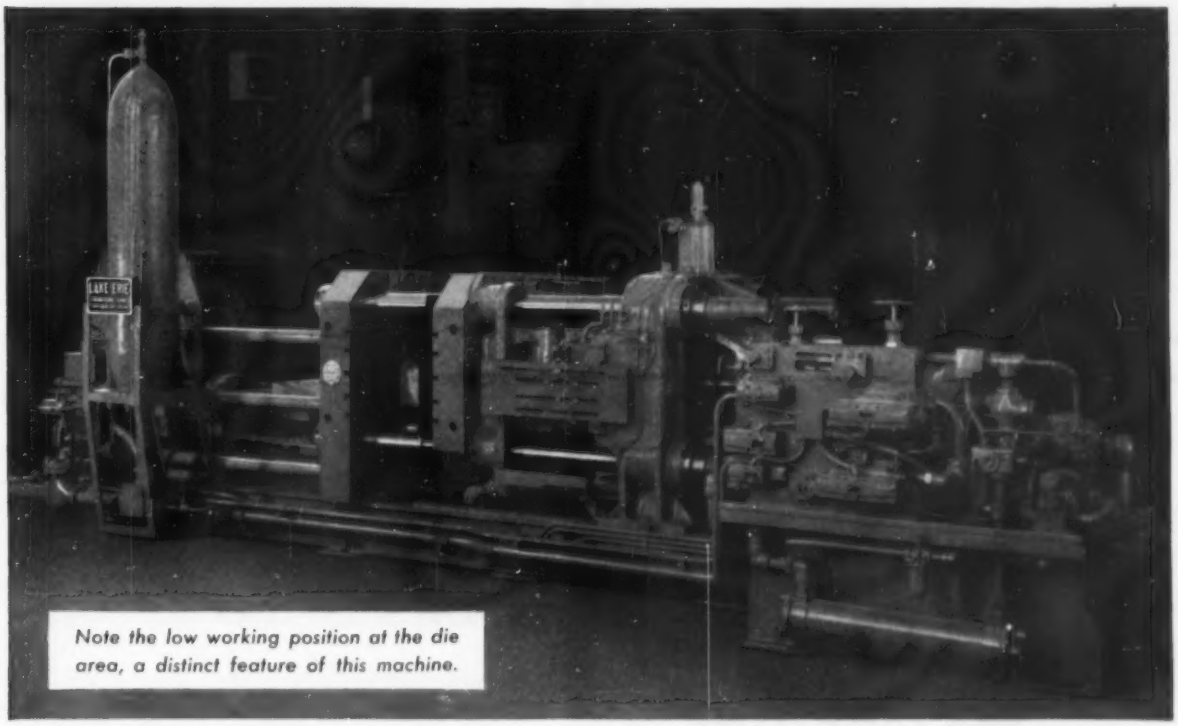
of Lake Erie Die Casting Machines



The Wedge Cam Toggle is a self-compensating clamp that *automatically* takes up clearances in the dies due to contraction and expansion of the molds during production or shut-down periods.

Pressure-Pac is a patented automatic pressure booster that produces sounder castings by feeding the shrink or compressing the porosity at the time of solidification of the metal.

● *Over 40 Lake Erie Die Casting Machines are now in service at The Electric Auto-Lite Company's plants.*



Note the low working position at the die area, a distinct feature of this machine.

Lake Erie die casting machines bring you features long desired but never before available in die casting equipment. The patented "Wedge Cam Toggle" and "Pressure-Pac" injection unit are the first major improvements in die casting equipment in many years. Repetitive purchases of these machines by companies like The Electric Auto-Lite Company, Ternstedt Division of General Motors and others assure you that Lake Erie equipment has no equal for quantity or quality of die castings. (Ask us about the new 16mm film describing Lake Erie machines.)

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Allis-Chalmers Mfg. Co.
Bendix Aviation Corp.
Bohn Aluminum & Brass Corp.
Central Die Casting & Mfg. Corp.
Davidson Mfg. Co.
The Dow Chemical Co.
Eclipse Machine Div. (Bendix)
The Electric Auto-Lite Co.
General Controls
General Electric Co.
General Motors—Ternstedt Div.
Hunter Fan & Ventilating Co.
Johnson Motors
Kiekhaefer Corp.
Ludman Corp.
McCulloch Motors Corp.
Outboard Marine & Mfg. Co., Ltd.
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Superior Die Casting Co.
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***WRITE** for Bulletin 23.2 — Contains Machine Specifications, Pressures, Capacities, Speeds, etc.*

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HYDRAULIC PRESSES • DIE CASTING MACHINES
ROLLING MILL AUXILIARY EQUIPMENT

For more information circle No. 80 on the Reader Service Card

Available From AS&R's Corpus Christi Plant
Most Modern In The Industry

American Smelting and Refining Company

MAIN SALES OFFICE: 120 BROADWAY, NEW YORK 5, NEW YORK

PRODUCERS OF: COPPER • ZINC • LEAD • ANTIMONY • ARSENIC • BISMUTH
GOLD • SILVER • PLATINUM • CADMIUM • INDIUM • TELLURIUM • SELENIUM

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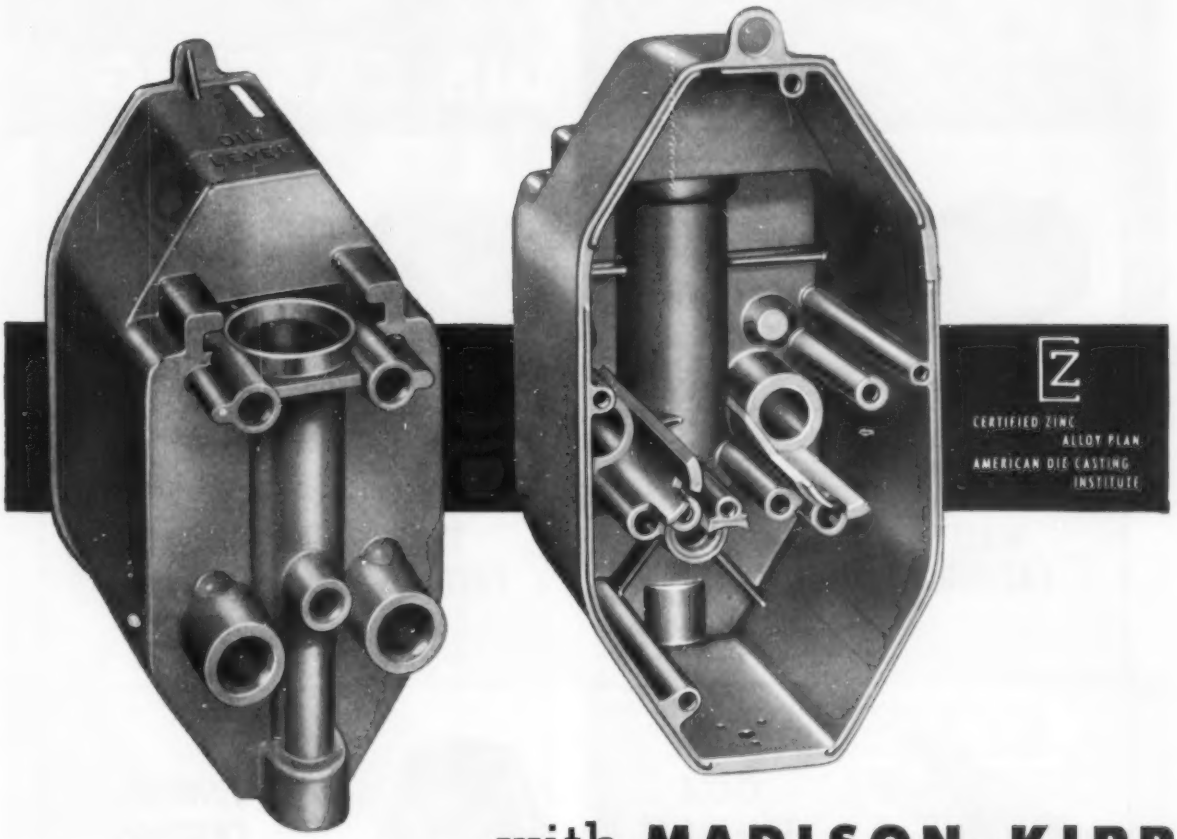
time tested designing...



with **MADISON-KIPP** zinc and aluminum die castings

Involved in the Oil Burner carburetor here illustrated is seasoned designing both by the principal and the die caster.

The product designer included a multiplicity of functions in one casting as the illustrations indicate. The die designing and the die making required expert handling by skilled craftsmen.

Millions of space heaters over the past quarter century have had as original equipment this or similar controls manufactured by Detroit Controls Corporation, Detroit, Michigan, with die castings made by Madison-Kipp Corporation.

When you have die casting requirements, please write to our home office in Madison.

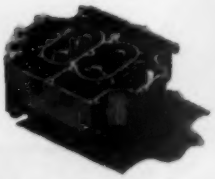
kipp

MADISON-KIPP CORPORATION
213 WAUBESA STREET • MADISON 10, WIS., U. S. A.

• Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools

For more information circle No. 43 on the Reader Service Card

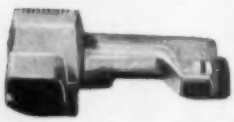
PRECISION *Can Do all This in* DIE CASTING



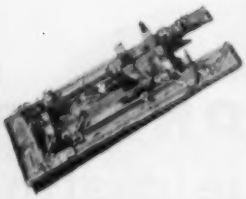
Complicated CASTINGS

LARGE CASTINGS

THIN WALL CASTINGS



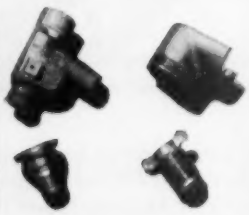
INSERTS IN CASTINGS



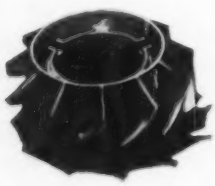
CLOSE TOLERANCE

FINISHED CASTINGS

EXTERNAL THREADS



FUNCTIONAL DIE CASTINGS



Call a PRECISION Engineer, Today!

*Since 1909 the name "PRECISION" has been the symbol of highest quality in the die casting industry

PRECISION CASTINGS CO., Inc.

212 Walnut St., Fayetteville, N. Y.

Syracuse, N. Y. · Cleveland, O. · Chicago, Ill.
Kalamazoo, Mich. · Cortland, N. Y.

British Affiliation — Wolverhampton Die Casting Co., Wolverhampton, England

For more information circle No. 54 on the Reader Service Card

Powdered Metal *magic*

—provided by Glidden Resistox Metal Powders

Through the magic touch of powder metallurgy, more and more products and parts are being produced with amazing speed, accuracy and economy.

Keeping pace with this growth, Glidden is a primary source of metal powders that meet all standards of purity, consistency and resistance to oxidation. Tests prove that Glidden Resistox Copper Powders have 5 to 10 times the stability of ordinary powders. That's why Resistox is widely used for bearings, friction materials, brushes and parts of all types.

Resistox Lead Powders also provide performance advantages important to this expanding industry. These powders are available in a complete range of coarse to fine sizes.

May we supply you with more data on these and other Glidden products for your field—Glidden Cuprous Oxide, Cupric Oxide and Cubond (Copper Brazing Paste)? Detailed information gladly sent to you on request.

QUALITY Glidden PRODUCTS

CHEMICALS PIGMENTS METALS

THE GLIDDEN COMPANY

CHEMICALS • PIGMENTS • METALS DIVISION

Baltimore, Md. • Collinsville, Ill.
Hammond, Ind. • Scranton, Pa.

For more information circle No. 25 on the Reader Service Card

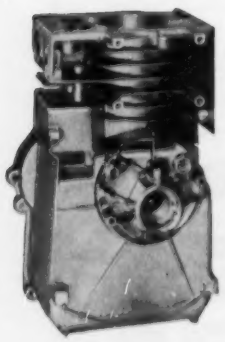
AJAX INDUCTION FURNACES

HELPED TO MAKE THIS RECORD FOR BRIGGS & STRATTON CORPORATION

More Than
1,000,000 INDUSTRIAL ENGINES
built in each of Two Successive Years

4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

With holding furnaces of 20 kW similar to that in the photo above, and melting furnaces of 100 kW, Briggs & Stratton Corp., Milwaukee, Wisc., is getting increased production under cleaner, more satisfactory working conditions than ever before, *and at lower operating costs.*



The intricate die-cast aluminum cylinder shown at the left is one of many produced at the B & S plant from high grade aluminum alloy melted in low-frequency AJAX induction furnaces. In these furnaces *only the metal is heated.* Energy is transmitted to the molten charge without actual contact through the refractory walls. There are no resistors or other parts having a higher temperature than is absolutely necessary for properly melting the charge. Overheating is avoided, and there is practically no oxidation.

The holding furnaces next to the die-casting machines as well as the melting furnaces are automatically controlled at a temperature within ±5°F., holding the metal at the lowest feasible casting temperature. The agitation due to internal electrical stirring in the metal gives the best conditions for holding furnaces, and there is little possibility of sludge formation at the bottom, because this is where the heat is generated.

AJAX

Write for Further Information to
AJAX ENGINEERING CORP., TRENTON 7, N. J.

TAMA-WYATT

INDUCTION MELTING FURNACE

AJAX ELECTRO METALLURGICAL CORP., and Associated Companies
AJAX ELECTROTHERMIC CORP., Ajax Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., INC., The Ajax Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax Wyatt Induction Furnaces for Melting

For more information circle No. 5 on the Reader Service Card

Here's a steam iron, travel-light, because of its DIE CAST sole plate!

CASE HISTORIES FROM MT. VERNON FILES

Think of it! An iron that presses efficiently both steam and dry, with 21 sq. in. of ironing surface — yet it weighs only 28 ounces, and folds into small space for traveling. That's the new "Stewardess," made by Landers, Frary & Clark, New Britain, Conn.

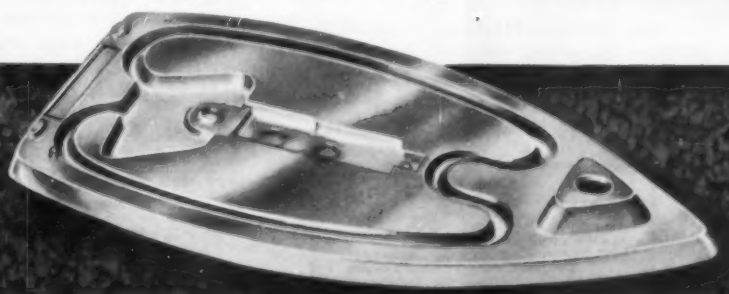
One basic reason this traveling iron is so sturdy yet so light is that the sole plate is of die-cast aluminum, made to the designer's exact specifications by Mount Vernon. The die-cast sole plate, containing a groove to hold the heating element, makes assembly quick, simple, economical.

Today as never before, die casting is helping manufacturers in widely separated fields to production economies and sturdy, reliable performance. For die-cast parts combine strength with light weight — and even with intricate designs die casting is done to such close tolerances you need little or no machining.

Mount Vernon can help **you** make the most of these die casting advantages by our complete Four-fold Service: **(a) *consultation*** — to help with design and production problems; **(b) *die making*** — on modern tool and die equipment handled by skilled personnel; **(c) *castings*** — guaranteed "on grade" at all times; **(d) *machining facilities*** — for handling machining operations your castings may require.

A switch to die casting may profit you tremendously. Why not consult with us?

MT. VERNON
DIE CASTING CORP.
STAMFORD, CONNECTICUT



For more information circle No. 46 on the Reader Service Card

Reference Data offered in this month's advertisements

2. DIE LUBRICANTS of the dry film type are fully described in reprint DC and Bulletin No. 426-M. Covered are both graphite and molybdenum disulfide. They are available from Acheson Colloids Co.

5. INDUCTION MELTING equipment for ferrous and non-ferrous metals is fully described in engineering data sheets available from Ajax Engineering Co.

8. SMELTERS ALUMINUM, the history and background of the smelting industry is discussed in a reprint available from the Aluminum Smelters Research Institute.

11. ALUMINUM DIE casting alloy, Z-39 is fully described and its physical properties, as-cast, given in specification sheets available from Apex Smelting Co.

15. POWDERED METAL parts made by the Bassick Co. are described in bulletin SM-54. Sintered metal wheels are featured in the bulletin.

16. MELTING STOCK for the investment casting industry and other small melt applications is listed in the new MasterMet bulletin. The chemistry and physical properties of the alloys are given.

21. FIRE RESISTANT hydraulic fluids of the water base type are described in a booklet "Ucon Hydrolubes" that is available from Carbide & Carbon Chemicals Co.

23. SMALL DIE CASTINGS, down to 1000 per pound are described in a Small Parts Folder that has been issued by the Dollin Corp.

24. REDUCE MACHINING costs through the use of permanent mold castings by Dostal Foundry & Machine Co. A booklet on how to cut production costs is available.

25. METAL POWDERS, particularly low in oxides are described in technical data sheets from the Glidden Co.

27. METALLIC FRICTION materials for all industrial applications are detailed in a booklet that has been brought out by General Metals Powder Co.

30. SPONGE IRON POWDER of a highly improved quality is described and all of its properties given in a data book from Hoeganaes Sponge Iron Corp.

31. IMPROVED DIE CASTINGS by the Hoover Co. are described and illustrated in a booklet "Hoover Die Castings."

32. A NEW DIE CASTING machine, built along entirely new and improved lines is described in Bulletin 5400 from The Hydraulic Press Mfg. Co.

35. POWDER METAL DATA book, giving the complete specifications and properties of HVA electrolytic iron powder and a multitude of applications is available from A. Johnson & Co., Inc.

37. HEAT EXCHANGERS for die casting machines and similar applications are described and the engineering data on them given in bulletin 1.1K5 from Kewanee-Ross Corp.

40. DIE CASTING applications, data and notes on die casting machines, plant tips and many other items of value to the die caster are in the Lester Press, house organ of Lester-Phoenix, Inc.

To get copies of any item listed here, simply circle the appropriate number on the Reader Service Card bound into this issue.

41. DESIGN BOOKLET giving valuable tips on the best and most economical design for die castings is available from Litemetal Dicast, Inc.

42. HOT CASTINGS and other materials handling on moving belts is discussed and considerable design and installation data given in bulletin MF-530, from May-Fran Engineering, Inc.

44. HIGH STRENGTH parts by powder metallurgy is possible with additions of Chrome-Nickel to iron powder. An engineering report on the properties and uses of this material is available from Metal Hydrides, Inc.

47. FIRE RESISTANT HYDRAULIC fluid for die casting machines and any other application where fire is a hazard is fully described in a booklet on Pydraul issued by Monsanto Chemical Co.

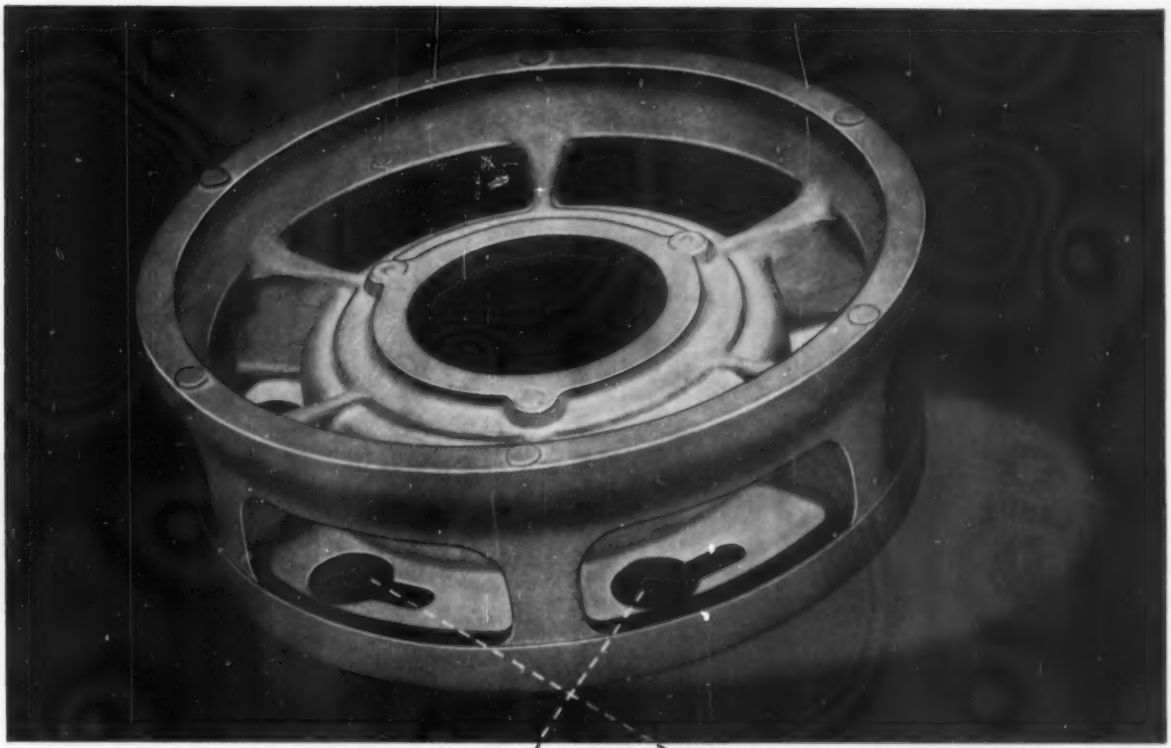
48. SELF LUBRICATING bushings in stock sizes can reduce assembly and machine costs. A stock list of standard sizes is available from National Molded Products.

51. BRASS POWDER compacts are successfully replacing both castings and machined parts. Complete information on the available powders, their properties and many typical applications is contained in a booklet "Facts About Pressed Brass and other nonferrous Powder Parts" published by New Jersey Zinc Co.

55. CASTING MACHINES for both zinc and aluminum die castings are described in literature from Peco Machinery Sales, Ltd.

56. DIE CASTINGS to specification is the subject of a new booklet

Continued on page 19



*FROZEN MERCURY INVESTMENT CASTING

MERCAST* Buttonholes

BUTTON A GENERATOR on or off of an airplane? Westinghouse does! And at a reported time saving of up to 8 man-hours per plane!

The ingenious new Westinghouse generator mounting bracket employs "buttonholes" that permit the assembly to be quickly slipped on or off over headed studs on the airframe. For practical production of this unit, a one-piece precision casting to close dimensional and surface tolerances is the economical answer. This casting, however, is much larger than can be produced by ordinary investment casting processes.

Westinghouse brought the problem to Alloy Precision Castings Company. Engineers and metallurgists at Alloy developed the illustrated 6 lb., 6½ inch diameter mercasting in 410 stainless. Critical tolerances are held to ±.003"/inch. Very little finish machining is required and the "buttonholes" are used as cast. Complete inspection by Alloy assures customers top quality and accuracy.

Mercasting made the Westinghouse generator mount idea a reality. Send details about your "impossible" or "too costly" jobs today! Learn how Alloy Precision can save you time and money with designs for mercasting.

A-5390

ALLOY PRECISION CASTINGS COMPANY, DEPT. C-63
45th and Hamilton, Cleveland 14, Ohio

Please RUSH Bulletin 706 describing the Mercasting Process.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____

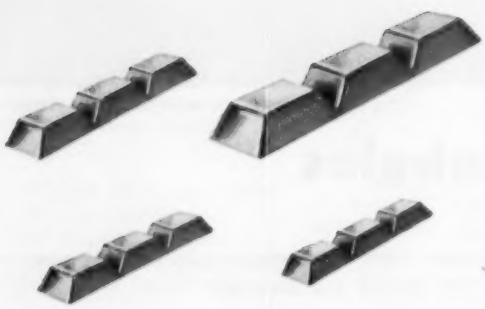
ZONE _____ STATE _____

ALLOY PRECISION Castings Company

EAST 45th ST. AND HAMILTON AVE. • CLEVELAND 14, OHIO

For more information circle No. 6 on the Reader Service Card

...ALUMINUM ALLOYS FROM SMELTERS ASSURE CONTINUED FOUNDRY GROWTH



Only the Aluminum Smelting Industry can be relied upon, unfailingly, for

the alloys you need

the variations you want

the quantities you wish

the deliveries you require

the services you should expect

the prompt attention you must have

All these come only as a matter of course from a supplier who looks upon you as his major customer—from the Aluminum Smelting Industry which for over 40 years has proved to be the one constant, reliable source of aluminum alloys for FOUNDRIES.

Today's comfortable overall supply of aluminum does not, in itself, guarantee that foundries' needs for aluminum alloys will remain readily available as a result.

Immense tonnages of aluminum will be consumed in the presently expanding wrought products mills now under way to provide for the increasing requirements for fabricated shapes in the construction, transportation, automotive, communication, and other fields. The increased aluminum production will insure supplies for those rapidly increasing wrought product applications, *but it will not assure the foundry its future aluminum alloy ingot supply.*

For over 40 years supplying foundry alloys has been the Aluminum Smelters major effort—it will continue so in the future.

* * * *

Like to know why the Smelting Industry is uniquely qualified to serve you? A recent article in "Modern Metals" discusses the history and background of the smelting industry—it is a frank discussion of the reasons for a feast and famine aluminum supply. Write for a free copy.

no foundry ever shut down because ingot was not available from smelters!

ASR

Aluminum Smelters Research Institute
20 North Wacker Drive, Chicago 6, Illinois

For more information circle No. 8 on the Reader Service Card

REFERENCE DATA
continued from page 16

that has been issued by the Racine Die Casting Co.

60. DIE LUBRICANTS by G. W. Smith & Sons, Inc. are listed and their uses and properties detailed in the "Die Slick Data File".

65. COST CUTTING with metal powder parts is the subject of an informative booklet issued by the Powdered Metal Products Div. of Yale & Towne Mfg. Co.

67. LIGHT METAL finishing methods using "Iridite" is fully described in technical data sheets from Allied Research Products, Inc.

69. DRILL UNIT for individual mounting featuring hydraulic feed and air powered advance is described in bulletin BL-5 available from the Bellows Co.

59. INVESTMENT CASTINGS, a description of the process, the equipment for making the castings and some typical applications are given in a 12 page booklet published by Alexander Saunders & Co.

72. PAINT SPRAY MASKS, their uses, automatic clamping machines, mask washing machines and all other supplies and equipment for spray painting parts.

72. PAINT SPRAY MASKS. The uses, clamping and cleaning of paint spray masks are described in leaflets available from Conforming Matrix Corp.

74. BARREL FINISHING MANUAL, a complete description of the process and the equipment for doing the work. Published by Minnesota Mining & Mfg. Co.

76. PAINT STRIPPING is the subject of a new booklet released by Oakite Products, Inc.

79. ADAPTERS, BUSHINGS and other similar equipment needed by die casters are described in a brochure and facility list published by Martin Grinding & Machine Works, Inc.

81. EJECTOR BOXES for die casters and die makers are described in specification sheets from Detroit Mold Engineering Co.

TWO machined parts $1.00
TEN Powdermet* PARTS .... $1.00 (10¢ each)

Don't cut parts—*Cut Costs* with YALE Powdered Metal Parts

Yes, powder metallurgy has an important price story—because when you save the extensive and costly operations involved in machining, it shows up in *more parts* and lower production costs!

But at Yale & Towne, there's another story of *equal* importance ... *complete* engineering service, the kind you can trust—from consultation through production and delivery of parts that are *really* right!

Engineering service has given Yale & Towne its position of leadership in powder metallurgy. We are careful to *recommend only applications where Powdermet* parts will perform successfully.* Then, in design and production of these parts, Yale & Towne offers the experience, know-how, modern facilities and creative ingenuity that *assure* best results.

As a part of this complete engineering service, Yale & Towne maintains a continuous special training program for well-qualified engineers. These men become Powdermet* consultants—available to discuss the advantages and limitations of Powdermet* parts *right in your own plant.* They will show you how Powdermet* may cut your production costs and improve your product. And there is *no obligation* for this engineering counsel.

TAKE ADVANTAGE of Yale & Towne's skilled engineering assistance on your powdered metal problems.

Arrange for a visit by a Yale & Towne consultant —today!

The world's most famous key
. . . symbol of industrial leadership!

YALE & TOWNE
MANUFACTURING COMPANY
PMP *Powdered Metal Products Division*
9335 Belmont Avenue, Franklin Park, Illinois

Send Today for Free Informative Booklet on Powdered Metals

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Powdered Metal Products Division
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☐ Send Booklet ☐ Send information on Powdermet* parts for attached specifications or drawings.
☐ Have a Yale & Towne Powdermet* engineer call on me.

Name.....Title.....
Company.....
Street Address.....
City.....Zone.....State.....

*TRADE-MARK

For more information circle No. 65 on the Reader Service Card

The most ever offered in a

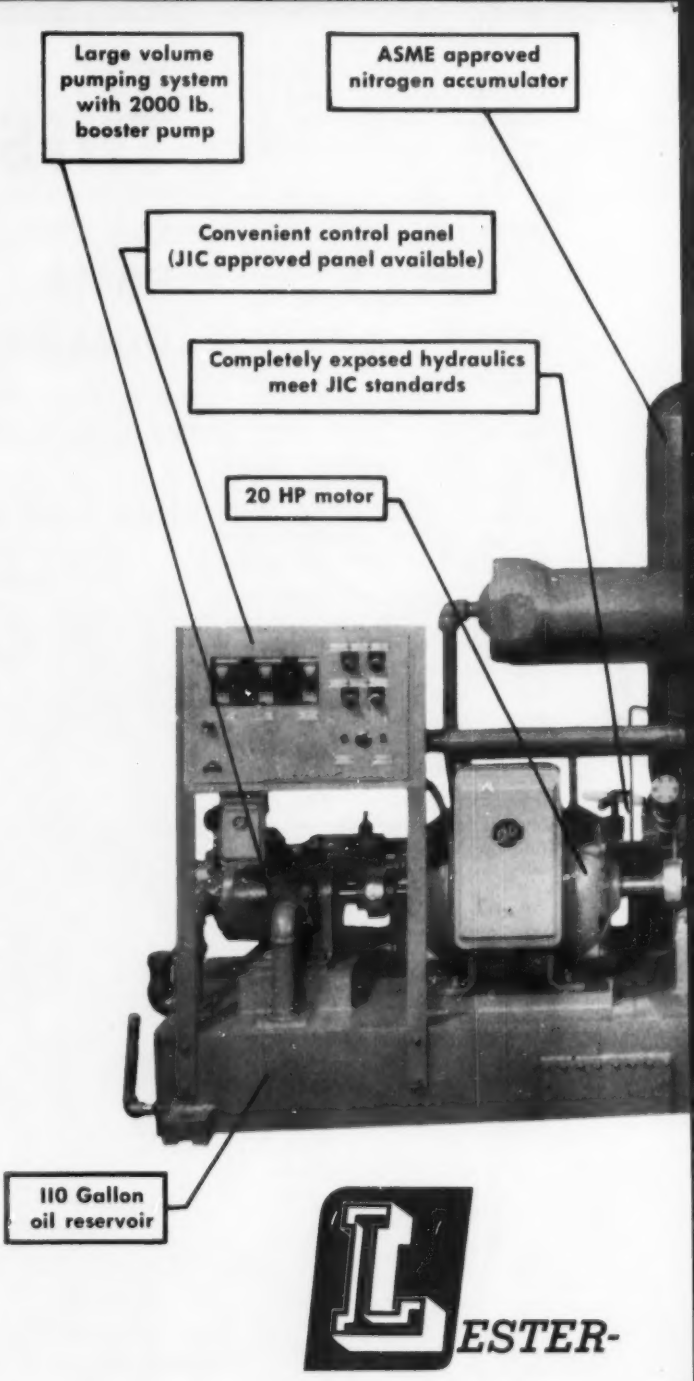
The LESTER-PHOENIX HP-2½X-SF for ALUMINUM DIE CASTING

Now that this new Lester has taken its place in the industry, the conception of a 400 ton die casting machine will have to be revised upward. The HP-2½X-SF has size, shot capacity, speed and unusual ruggedness that makes it—on the basis of any comparison, including price—the leader in its class.

The backbone of this exceptional machine is the solid steel frame assembly which, combined with the massive toggle links, develops 400 tons of clamp—based not on designer's calculations, but on actual strain gauge tests! This basic structure, in turn, permits all of the outstanding features shown here.

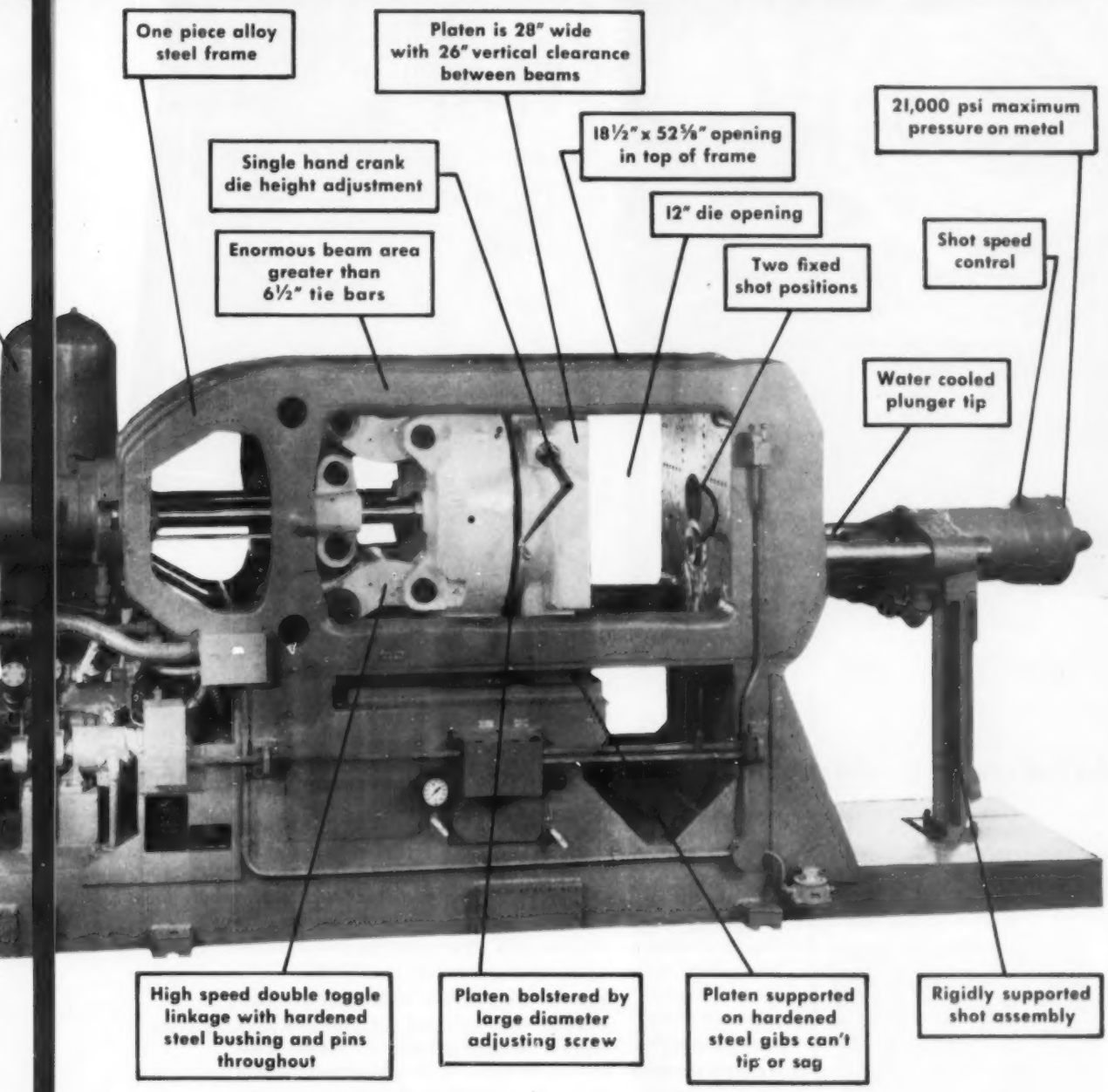
And there are many more: ranging from automatic hydraulic ejection to convertibility to zinc die casting. For complete specifications write today to Lester-Phoenix, and also ask for regular copies of our house organ, "The Lester Press".

The HP-2½X-SF is also offered with the Pre-Fill injection system, increasing maximum shot pressure to 32,000 psi and also increasing shot speed.


Large volume pumping system with 2000 lb. booster pump
ASME approved nitrogen accumulator
Convenient control panel (JIC approved panel available)
Completely exposed hydraulics meet JIC standards
20 HP motor
110 Gallon oil reservoir

LESTER-

400 Ton die casting machine


One piece alloy steel frame
Platen is 28" wide with 26" vertical clearance between beams
18½" x 52⅝" opening in top of frame
21,000 psi maximum pressure on metal
Single hand crank die height adjustment
12" die opening
Shot speed control
Enormous beam area greater than 6½" tie bars
Two fixed shot positions
Water cooled plunger tip
High speed double toggle linkage with hardened steel bushing and pins throughout
Platen bolstered by large diameter adjusting screw
Platen supported on hardened steel gibs can't tip or sag
Rigidly supported shot assembly

PHOENIX DIE CASTING MACHINES

REPRESENTATIVES

New York	Steven F. Krould	Seattle	Perine Machinery & Supply Co., Inc.
Detroit	Thoreson-McCosh	Cincinnati	Index Machinery Corp.
Chicago	J. J. Schmidt	Los Angeles	Seaboard Machinery Co.
Cleveland	Don Williams	San Francisco	J. Fraser Rae
Coral Gables	Morton Machinery Sales	St. Louis, Milwaukee	A. B. Geers

FOREIGN

Toronto, Canada	Modern Tool Works, Ltd.
Sydney, Australia	Scott & Halladay, Ltd.
Japan	Okura & Co., New York, Inc.
Stockholm, Sweden	Aktiebolaget Servus
Basle, Switzerland	Hermann Walti

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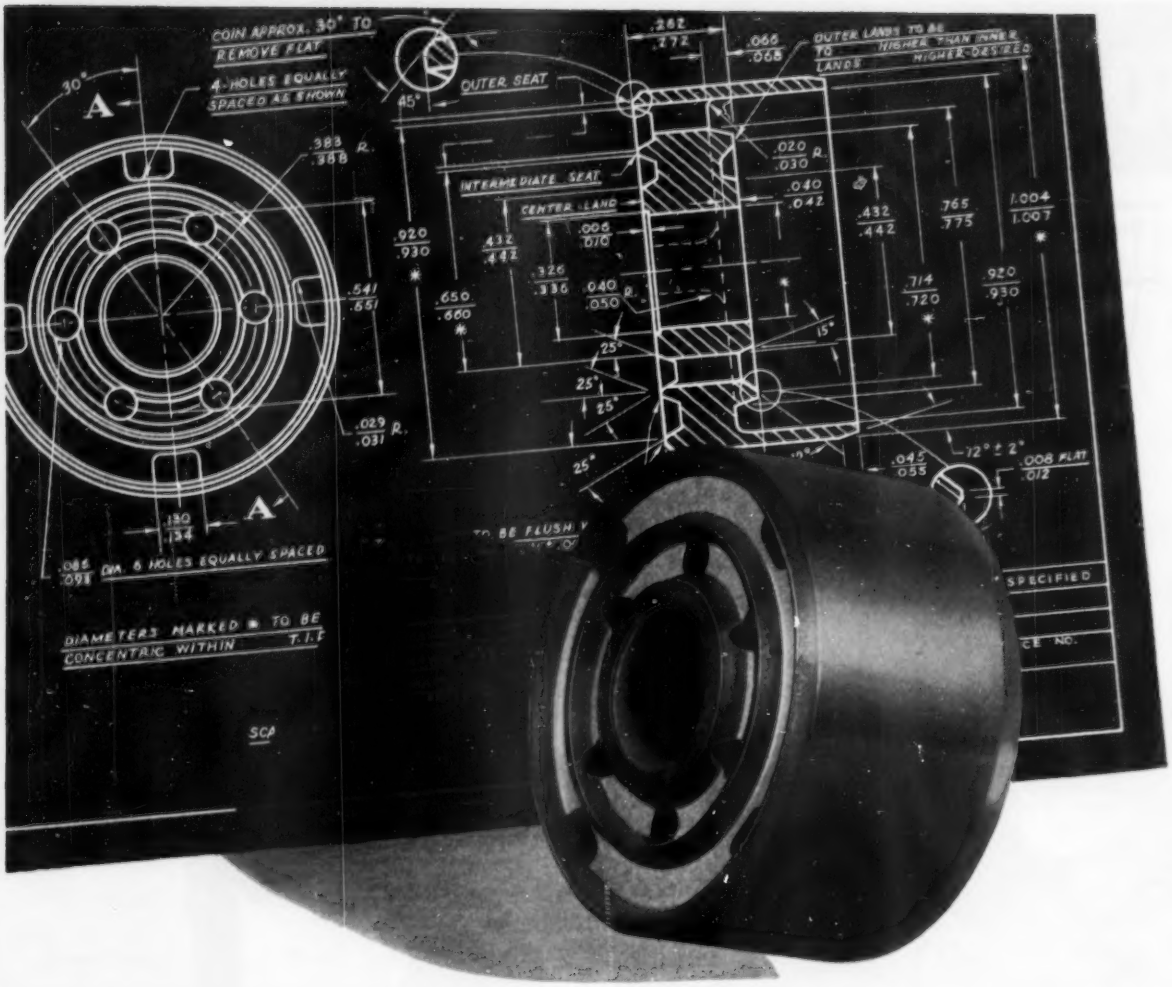
COIN APPROX. 30° TO REMOVE FLAT
4 HOLES EQUALLY SPACED AS SHOWN
OUTER SEAT
INTERMEDIATE SEAT
CENTER LAND
OUTER LANDS TO BE HIGHER THAN INNER LANDS
DIAMETERS MARKED * TO BE CONCENTRIC WITHIN T.I.P.
.085 .098 DIA. 6 HOLES EQUALLY SPACED
72° ± 2°
.008 FLAT .012
SPECIFIED

MORAINE MAKES MANY COMPLEX PARTS IN ONE OPERATION

A design can be so complex that the cost of making it by conventional casting and machining methods would be prohibitive. Yet, that same design can be produced by the Moraine metal powder process at moderate cost—usually in one press operation—with no drop-off in quality or precision.

For example, this part, of intricate design and close tolerances, is made in quantity every day at Moraine with very noticeable savings to the customer. It illustrates how much can be done to improve performance and cut costs when customer and Moraine cooperate to adapt part to process.

Moraine's experience with powder metallurgy is extensive and the possibilities it offers to modern industry are almost limitless. There are very few design ideas that cannot be profitably converted into practical parts by the Moraine metal powder process.

m moraine products
DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

METAL POWDER PARTS

Between the Lines of this and future issues

TITANIUM JOINS THE RANKS . . .
Titanium has been described in glowing terms by many engineers and metallurgists, and its properties certainly promise great things in aircraft design. However, suitable ways to fabricate it must be found. For example, casting titanium is especially difficult. Now, a technique and equipment have been developed for investment casting titanium, as described in this issue.

WHICH FIRE-RESISTANT HYDRAULIC FLUID TO USE? . . .
Two general types of fire-resistant hydraulic fluids are coming into general usage in die casting machines. Beginning in this issue is a discussion of the factors to consider in your choice of a fluid . . . Shall it be aqueous or non-aqueous? Also, the editors of PMM have been fortunate to obtain a report on a method of reclaiming these hydraulic fluids, thus overcoming the problem of the higher price per gallon, as compared with conventional oils.

WHAT IS A DIE CASTING? . . .
This simple question will probably stump many designers, even though they can recognize one at a glance and have been designing them for years. The fourth in PMM's series of basic articles describing the precision casting methods is presented in this issue for the benefit of designers, production engineers and purchasing agents. It tells the characteristics of die casting. In February, PMM will give a similar report on shell mold casting.

A BARREL VERSUS A BUNDLE . . .
What advantage does a barrel of iron powder have over a bundle of steel bars? Any production man who has had to get bar stock of non-standard sizes to meet manufacturing schedules knows that speed of procurement is the difference. A barrel of iron powder can be made up into an unlimited range of sizes and shapes; a bar can only be machined or shaped by expensive processes. This is why Detroit Diesel is using more and more powdered iron parts, as described in this issue.

VINYL COATINGS OVER DIE CASTINGS . . .
You can follow, step-by-step, the application of vinyl plastic coatings to die cast oil control valves in this issue, with a discussion of some of the advantages, problems, and methods of applying.

HOW TO SELL MORE TOYS (OR FUEL PUMPS) . . .
You can sell more toys, (or any item sold from the shelf) if you give a little thought to the type of finish you apply. How one toy manufacturer increased the sale of his die cast products by the hundreds of thousands, by improving the appearance, will be related in an article in PMM next month.

Find Out Why You Get

Freedom from . . .
1 Porosity
2 High Cost Material
3 Expensive Machining
4 Metallurgical Variation

with
PERMANENT MOLD
Gray Iron Castings

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Permanent Mold Gray Iron Castings by DOSTAL offer many advantages. Their structure is uniform and surface scale is eliminated. These 2 factors permit higher speed machining with faster feeds. The dimensional accuracy and uniformity of DOSTAL Permanent Mold Castings reduces machining operations to a minimum. Permanent molded castings are uniform in hardness and their structure is dense and porous-free.

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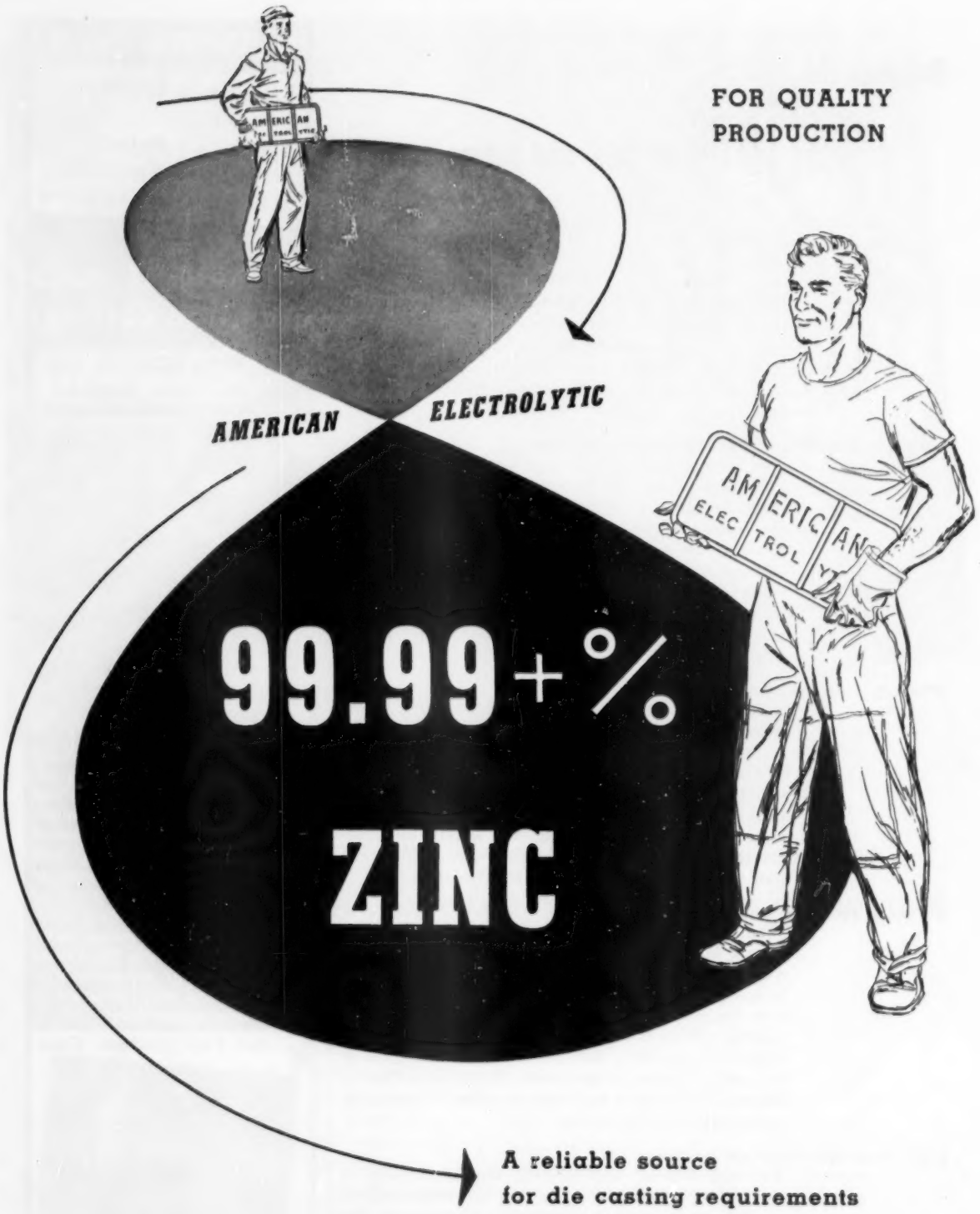

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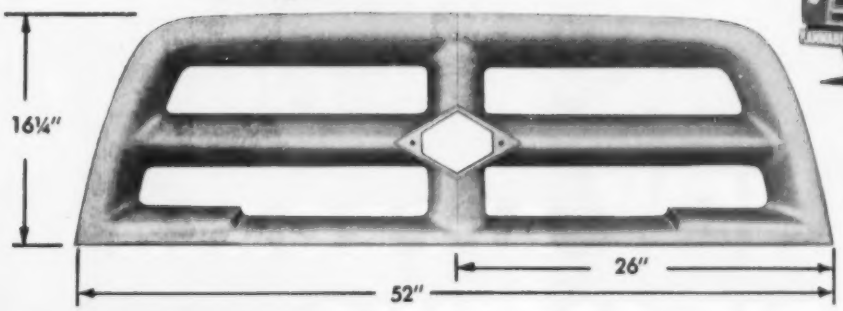
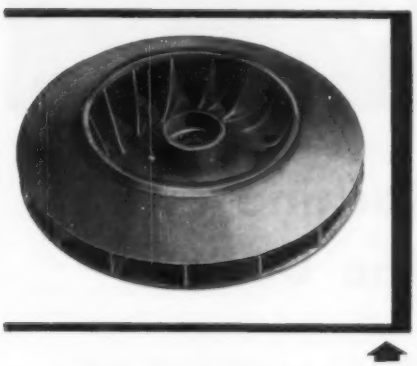
ACME *Engineered* ALUMINUM & MAGNESIUM CASTINGS

An aluminum permanent mold grille casting engineered and manufactured for the Diamond T Motor Car Company.





A typical Acme casting for a defense product. Fin sections have a wall thickness of 3/16".

Consulting with Acme engineers may save you many headaches and dollars on production jobs.

We welcome your requests for this service.

Acme aluminum and magnesium castings are engineered to meet the most exacting requirements for defense or civilian product applications. Whether you manufacture trucks, home appliances, vending machines, business machines or some other type of fabricated metal product requiring light metal castings, Acme can supply your needs. We also offer aluminum and magnesium heat treated and aged castings to meet military specifications.

This all adds up to a *complete casting service*, including aluminum alloy permanent mold and semi-permanent mold castings and aluminum and magnesium alloy sand castings. This complete casting service backed by 33 years of engineering and foundry experience provides you with your best source for top quality light metal castings.

PHONE **PROSPECT 6-5035**

ACME ALUMINUM FOUNDRY CO.

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A NEW APPROACH TO DIE CASTING

New H-P-M Die Casting Machine offers more than just New Machine Design

The new H-P-M die casting machines are being hailed as the most important advancement in die casting in fifteen years, and rightly so . . . more than forty new and improved features! These features result in minimum mold flash . . . faster die set-up . . . greater versatility in die usage and casting design... reduced maintenance . . . maximum safety and performance. The new self-contained Link-Wedge mold clamp is the best. There's plenty of "beef" in these new models. They are available in a complete range of sizes...cold chamber or gooseneck types.

Write for Bulletin 5400 which describes these new units in detail.

HPM

THE HYDRAULIC PRESS MFG. COMPANY
1094 Marion Road, Mount Gilead, Ohio, U. S. A.

For more information circle No. 32 on the Reader Service Card

BOOKS

STRENGTH and RESISTANCE OF METALS by John M. Lessells. John Wiley & Sons, Inc., New York, N. Y. Price $10.00

In his preface the author of this book says; "Design of machine elements is no longer based upon empirical relations; rather, analytical methods involving advanced theory have become more common in solving engineering problems. However, these more exact solutions can be usefully applied in design only if information is available on the manner in which engineering materials behave under applied stress.

"The aim of this volume on the strength and resistance of metals is to provide the senior and graduate student as well as the design engineer with information on the behavior of metals under stress as it has been revealed by numerous workers in this field."

Even a cursory examination of the book reveals that the author has amply fulfilled his aim. Covered in the book are tension at room and elevated temperatures, hardness, impact, fatigue, fracture, strain hysteresis, mechanical wear and theories of strength and working stresses.

AIR AND HYDRAULIC CYLINDERS IN INDUSTRIAL APPLICATIONS — by Elmer F. Heiser, Industrial Publishing Group, 1240 Ontario St., Cleveland, Ohio. Price $5.00.

The first book of its kind — written by a practical man for practical men — "Air and Oil Cylinders in Industrial Applications" is devoted exclusively to fluid power cylinders.

Continued on page 77

YOU CAN IMPROVE YOUR PRODUCT
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Gears and impellers in a wide variety of Universal alloys.

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- Exceptional Physical Properties

In addition to these values you can keep your machining and original tooling costs low. UNIVERSAL Castings are now being used in many original equipment applications, such as by the electrical, automotive, appliance, aircraft, and marine industries.

A NEW HIGH STRENGTH CASTING PROCESS
UNIVERSAL Castings patented method of low temperature pouring produces a material having a much denser structure than castings produced by ordinary methods. The unusually high strength developed in this material has caused it to be in great demand for use in Aircraft fuel pump impellers, torque convertor wheels, air compressor impellers, and many other highly stressed casting applications. Accurate detail and sections 1/32" thick can be produced consistently.

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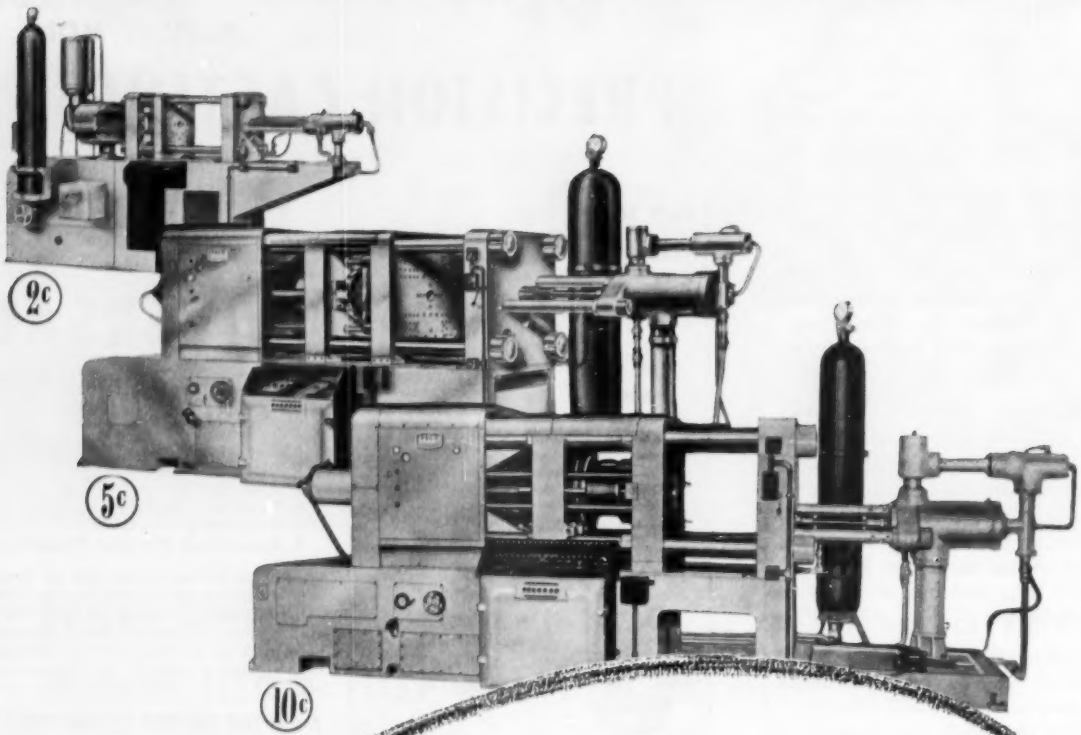
Thousands of Different Castings all with the same 'PECO' PRECISION



Exact mouldings reduce to a minimum the need for machining.

PECO DIE-CASTING MACHINES are proving daily the benefit of their unique ELECTRICAL CONTROL, which covers every movement of the cycle, ensuring continuity and uniformity of production.

The machine has four core-pulling connections, two for each platen, a built-in central hydraulic ejection cylinder and four bumper bars for mechanical ejection.

All these mechanisms are fully interlocked and controlled, permitting operation in any sequence.

By using the central hydraulic ejector as a core-puller the effective die opening may be increased by as much as six inches.

The company has also developed an important new range of HOT CHAMBER die-casting machines, which will be of considerable interest to manufacturers.

PECO PRODUCTS

We shall be glad to forward to you on request fully illustrated literature on these machines.

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WORKS: THE PROJECTILE AND ENGINEERING COMPANY LIMITED, ACRE STREET, LONDON, S. W. 8, ENGLAND

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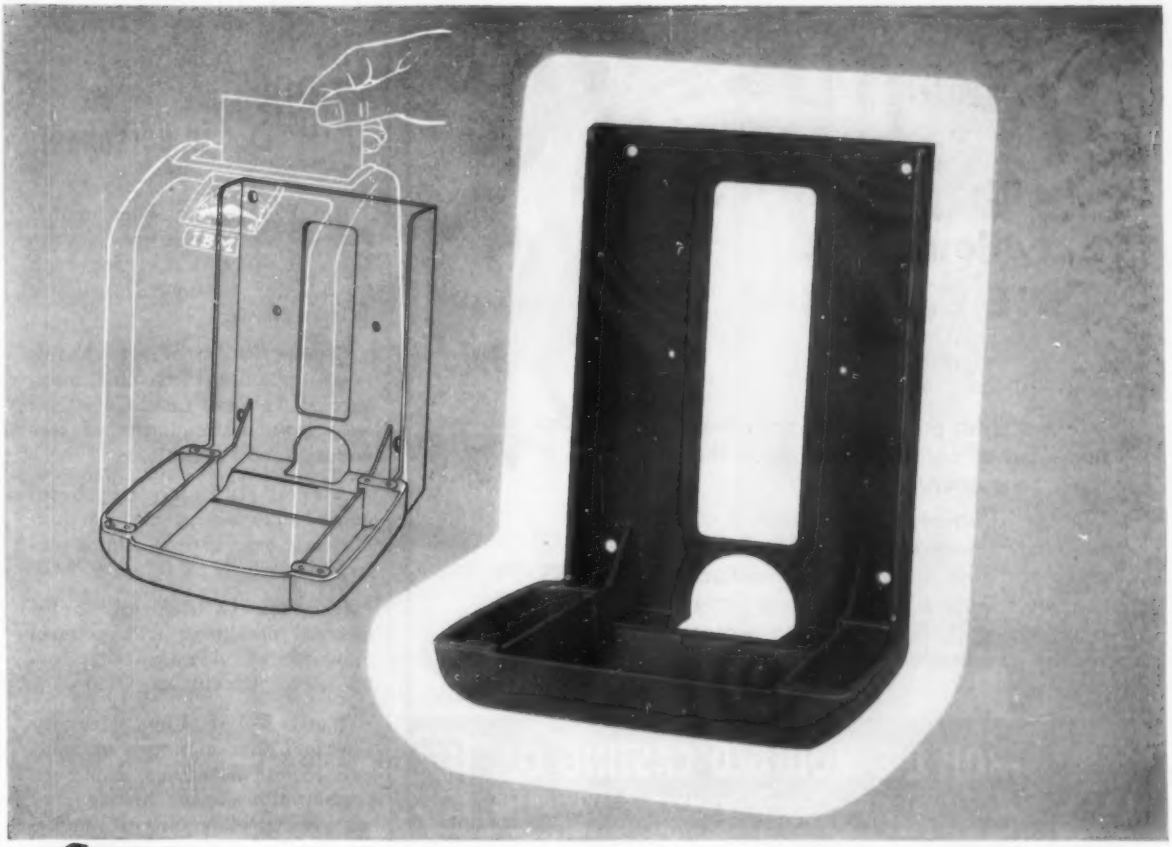

TIME MARCHES ON *automatically . . . supported by* PARKER DIE CASTINGS

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IBM'S fully-automatic, electric time recorder is a far cry from the old-fashioned time clock. This modern engineering development handles with ease and sureness any kind of work schedule, no matter how complex. To produce the wall mounting bracket shown above, IBM and Parker together worked out the design of the part. The result: a die casting that meets every specification at lower total cost.

This close co-operation from blue print to finished product typifies the complete engineering—as well as manufacturing—service offered by Parker. No matter how complex your die casting problem, Parker will be glad to help you find the answer. Just call the nearest Parker sales engineer listed at the left or write the factory direct.

Parker White Metal Company • 2153 McKinley Ave., Erie, Pa.

PARKER **ALUMINUM and ZINC *die castings***

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STROH

Has Been Producing Excellent ZINC DIE CASTINGS Since 1903

We are a bit proud of the fact that numerous of our customers are in the third generation.

"Teddy" Roosevelt was president of the United States when STROH first produced zinc die castings. The fact that we still serve many of these early accounts, we believe, speaks volumes for the excellence of our product.

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STROH DIE MOULDED CASTING CO.
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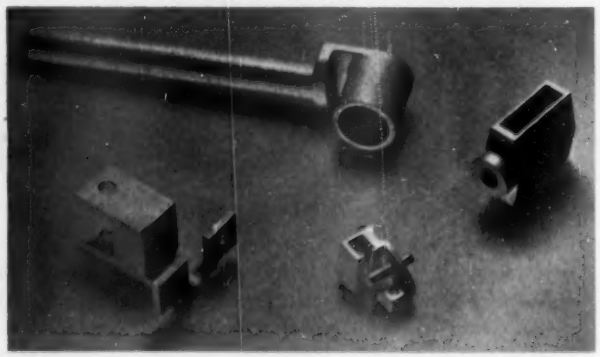
These parts were cast by Z&H MFG. CORP. by the "LOST WAX PROCESS" thereby eliminating costly machining operations



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Changes in personnel

Ray P. Dunn has been named director of metallurgy for the *U. S. Reduction Co.* for both their East Chicago and the Toledo plants.

Robert W. McKittrick has been appointed assistant manager of *National Lead Co.'s* Chicago branch, in charge of secondary metal operations.

Alfred H. Lewis has been named sales manager of *Vacuum Metals Corp.* with headquarters in Syracuse, N. Y.

Harrison O. Ash has been elected president and general manager of *Aluminum Industries, Inc.*, Cincinnati, Ohio.

Ward W. Minkler, formerly Pacific Coast manager of sales and technical service, has been appointed assistant manager of market development of the *Titanium Metals Corp. of America.*

Ernest R. Dondorf, manager of metal purchases for *National Lead Co.*, was honored at a luncheon recently by his associates on the occasion of his 48th anniversary as a National Lead employee.

Raymond H. Matthews has been appointed chief engineer of *Fenwal, Inc.*

George W. Belcher has been appointed central district manager of sales and technical service of the *Titanium Metals Corp. of America.*

Promotions announced by the *Parker Rust Proof Co.* of Detroit include: **Dr. R. C. Gibson,** formerly technical director, will be assistant vice president; **E. W. Richards** will be technical director; **R. I. Peterson,** service manager; and **C. F. Rasmussen,** assistant service manager.

James H. Johnson and **Donald E. Hamilton** have joined the sales staff of *Wesson Metal Corp.*, producers of carbide metals.

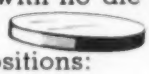
Continued on page 32

Here's real help for designers of parts for...

Now You Can Prove To Yourself The Value Of High-Density HVA Electrolytic Iron Powder Parts

Not every part needs high-strength and high-density. But if yours is one that does . . . if it involves complicated shapes or calls for high impact strength or extreme ductility plus high tensile strength, then you owe it to your product to see what HVA electrolytic iron powder can do.

HERE'S HOW

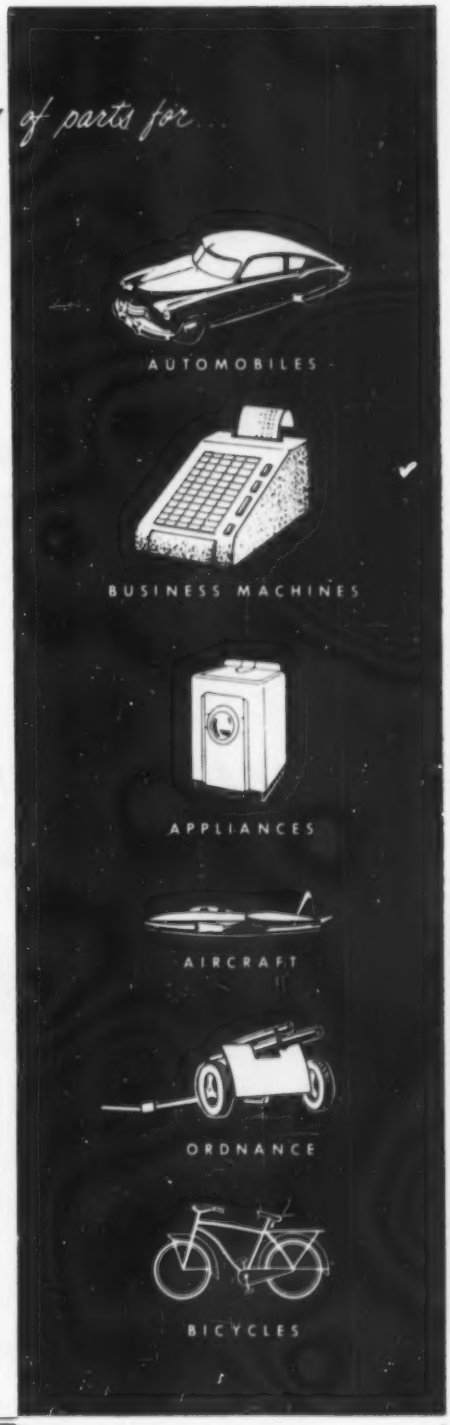
A new service helps you make low-cost initial tests (with no die costs.) We will send you sintered slugs  in any of these heat-treatable compositions:

1. Pure HVA Electrolytic Iron Powder	2. HVA Electrolytic Iron Powder Plus 2% Copper	3. HVA Electrolytic Iron Powder Plus 3% Copper

Machine your own parts from them. Then put them to performance tests in your own machines. Prove to yourself that parts of HVA powder can replace components now made by other processes — and put an end to expensive machine operations. That's the way Husqvarna does it in its own shops. Fair enough?

Use the coupon below.

You ought to have a copy of this new engineering data book. 48 pages of technical facts for designers and fabricators. Free for the asking.



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Gentlemen:
Please send me, at no obligation to myself:
- ☐ Details on your new slug service
- ☐ Copy of the HVA data book

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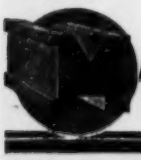
Die Castings by MILWAUKEE

...for Extra Values at No Extra Cost!

A pioneer in its field, Milwaukee offers you the experience and knowledge gained in helping others for more than 40 years, to realize the full benefits of the die casting process. In its modern plant, it offers you the most advanced facilities for the production of zinc and aluminum die castings. These extra values which cost you no more, can help you build extra values into your product, too.

We operate under the Certified Zinc Plan of the American Die Casting Institute, Inc.



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Established 1909

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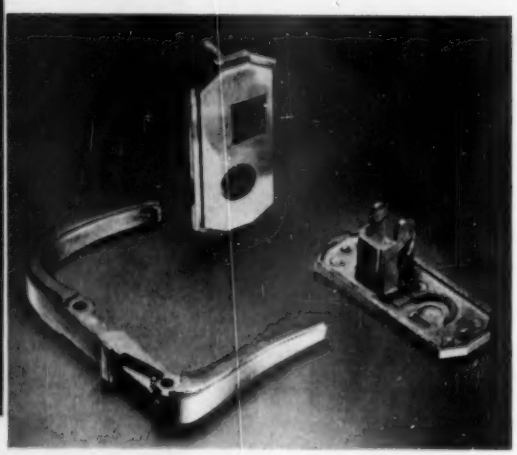

Builders' hardware is only one type of product making use of Nelson die castings. Our customers manufacture a wide range of products, including cars, appliances, machinery, aircraft devices, furniture . . . and many more. This simply proves that whatever your product, Nelson can help you solve your production problems and cut costs. Let us quote on your prints or discuss your current parts problems.

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CHANGES IN PERSONNEL

continued from page 30

Ruel E. Warriner has been appointed vice president in charge of sales of *Climax Molybdenum Co.*

Edwin A. Wert has been appointed sales representative in California, Nevada and Arizona for *National Precision Casting Corp.*

T. Kenneth Haven has been named vice president of the *Detrex Corp. of Detroit.*

James H. Moore has been appointed general manager of *Vacuum Metals Corp.* of Syracuse, N. Y.

Power Drives, Inc., owned by **Lawrence C. Darbrake** and **Vincent G. Mansell,** has been appointed exclusive representative for western New York State by *Lindberg Air & Hydraulic Div., Lindberg Engineering Co.*

W. E. Sherwood of Evansville, Ind. who has represented *Du-Wel Metal Products* in Kentucky, Tennessee, and Southern Illinois has been assigned Southern Indiana as part of his territory.

The Industrial Products Sales Co. has been appointed as representative in Ohio for *National Precision Casting Corp.*

Philip V. Tarr has been named as chief engineer and secretary of the *Nut Corp. of America.*

Robert A. Kempe has been named vice president, treasurer and general manager of the *Metalphoto Corporation,* Cleveland, Ohio. Kempe, who will direct production and sales, was formerly division sales manager of *Thompson Products, Inc.*

Martin I. Lamont has been appointed assistant sales manager of the Chicago District for *Kaiser Aluminum & Chemical Sales, Inc.*

Dr. Robert L. Womer has been named vice president in charge of research and development by *Speer Carbon Co.* of St. Marys, Pa.

IF YOU MAKE ANY OF THESE

you now have a new domestic source of high-quality iron powder

Iron powder of unrivaled purity—consistently uniform—ton after ton, is now coming from Republic's new plant at Toledo, Ohio. It is being made by the hydrogen reduction process. Present capacity is 3500 tons a year.

Republic's Iron Powder is manufactured exclusively from Adirondack magnetite ore that yields a concentrate of the highest quality. Republic is the sole owner.

Republic's processing operations are such that the quality of the concentrate is maintained uniformly consistent.

REPUBLIC'S IRON POWDER GIVES YOU THESE DISTINCT ADVANTAGES:

1. Particle size and distribution is controlled by preparation and characteristics of the base material.
2. Good green and sintered strength aid you as a designer in attaining your goal of strength and capabilities. Or, if you are a fabricator, these strengths reduce your problems of process and handling.
3. Uniform shrinkage and growth characteristics aid you in die design and in establishing the finish dimensions of parts.
4. Acceptable limitations on flow rate, hydrogen loss, screen and chemical analysis have been established and will be maintained for uniformity of product.

Our engineers and metallurgists are available to help you use Republic Iron Powder to the best advantage. Write us for more information and a sample of Republic Iron Powder.

- Automotive parts
- Home appliances
- Bearings and bushings
- Oil and water pumps
- Farm machinery
- Textile machinery
- Business machines
- Friction materials
- Piston rings
- Fractional horsepower motors
- Toys
- Builders' hardware
- Electrical equipment
- Small arms
- Bicycles, motor-scooters, motorcycles
- Gears
- Ordnance parts

REPUBLIC STEEL CORPORATION

Alloy Steel Division • Massillon, Ohio

GENERAL OFFICES • CLEVELAND 1, OHIO

Export Department: Chrysler Building, New York 17, New York

REPUBLIC STEEL

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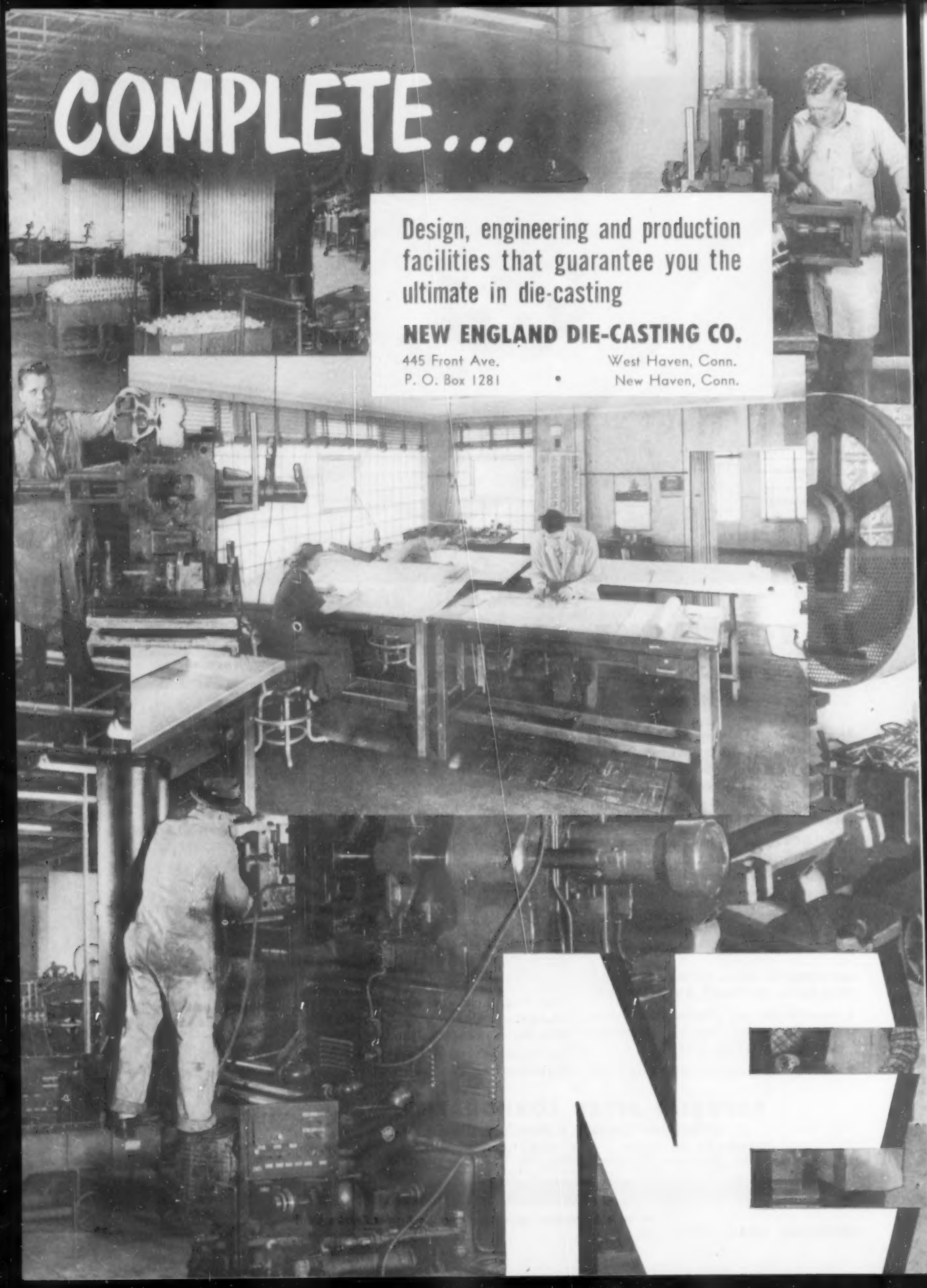
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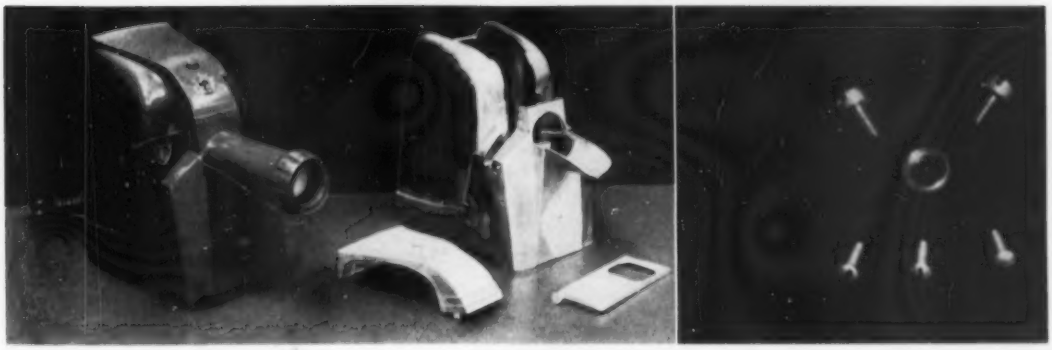
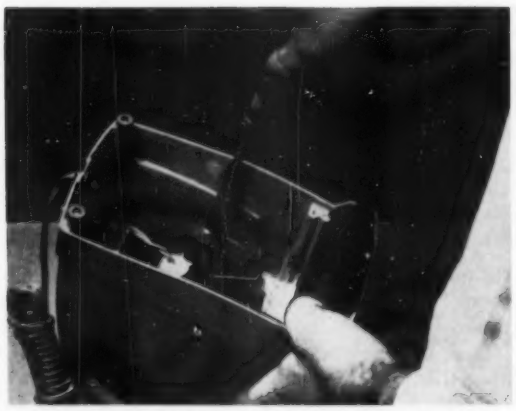


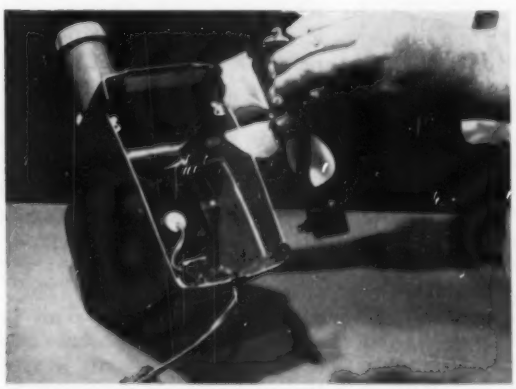
Three Die Castings And Five Screws Permit . . .

Final Assembly In Seconds

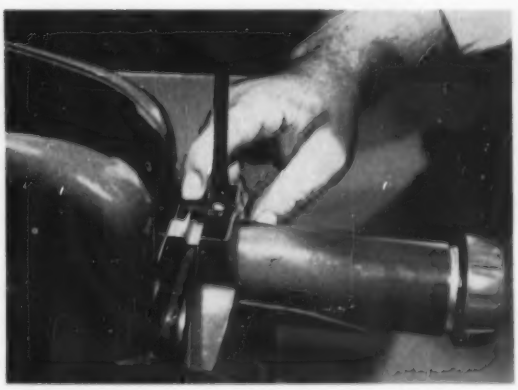


IN GOES THE OPTICAL SYSTEM. The prealigned optical system is fastened in place with two self-tapping screws. Holes for the screws are drilled by the die caster, who also reams the aperture opening into which the lens barrel is to fit.

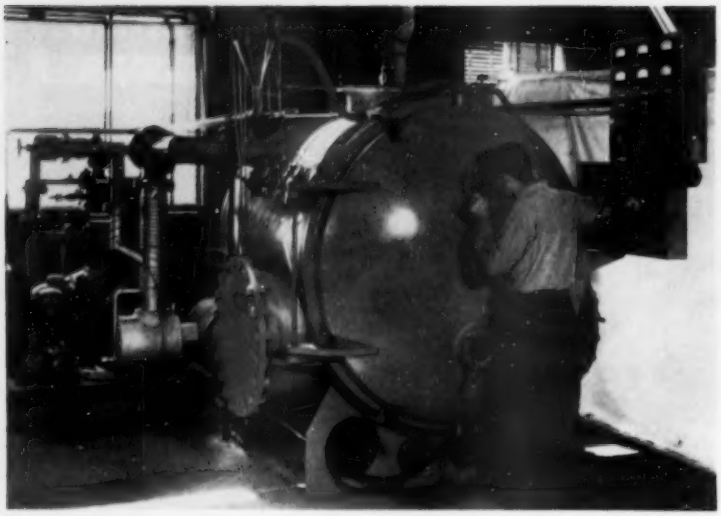
AN object lesson in simplified assembly is this handsome "Skot" slide projector developed by American Optical Co. Working closely with them, the die caster, Precision Castings Co., produces three major parts as aluminum die castings. Two of these, housing and cover, are in type 380 aluminum alloy (3.5% Cu, 9% Si), whereas the slide changer is cast of type 218 alloy which contains no silicon. This permits American Optical to apply a jet black anodized finish for durable protection. The two die castings for housing and cover take the place of the more than 20 sheet metal parts it takes to fashion a conventional projector hood, eliminating many rivets and spot welds.

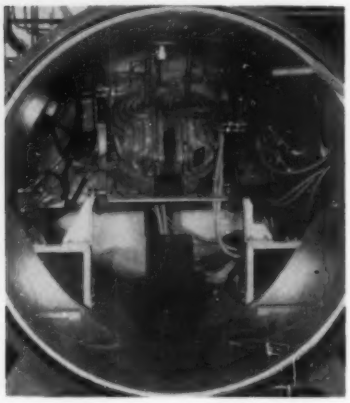


IN GOES THE MOTOR-BLOWER UNIT. Two knurled thumb screws hold this sub-assembly in the die casting. Male plug automatically connects motor to wiring harness when placed in position. Accuracy of the castings permits speedy assembly.



IN GOES THE SLIDE CHANGER. One self-tapping screw holds the slide changer in place. Die cast slide changer has about as many pieces as one made entirely from sheet metal, but costs a lot less — $.35 as against $1.35 for the sheet metal.





1. SKULL FURNACE, left, melts 50 pounds of titanium. Interior of the chamber is shown below.

Titanium Melting And Casting

By D. I. SINIZER
National Research Corporation

Titanium and its alloys have many useful properties and characteristics, but the utilization of these desirable qualities depends upon the development of practical methods for fabricating this metal. Here is a report on a recently developed technique for casting shapes from titanium.

CASTINGS of titanium and its alloys have been made by the Research Division of the National Research Corp. for the past three years. Since the physical properties of titanium are seriously impaired by contamination with oxygen, nitrogen or carbon from any source, extremely rigid control of furnace atmosphere must be maintained at all times. Melting and casting must, therefore, be done under vacuum or inert atmosphere.

Development work on the casting process has been carried forward in a laboratory furnace capable of producing castings weighing up to about 4 to 5 pounds under vacuum or inert gas atmosphere at low pressure. Only the physical limitation of furnace size and capacity prevented the pouring of larger castings.

Investment castings of titanium and titanium alloys have been made with excellent precision using modifications of standard techniques. Split mold castings in specially prepared molds have been made with good surface finish, a high degree of soundness and good physical properties. The process is covered by patent applications.[1]

The Equipment Division of National Research Corp. has designed and constructed vacuum equipment and many special metallurgical furnaces for use in industry. The most recent of these is a skull furnace specially designed for casting up to 50 pounds of titanium or its alloys. The advent of this furnace makes possible for the first time the commercial melting and pouring of large castings or a series of several smaller castings from a single melt.

Two of these new skull furnaces have now been built. The first is in daily use in the NRC's Research Division laboratories. The second unit is being erected in the Titanium Casting Corp., Division of Howard Foundry

Co., a licensee on the process. Titanium or titanium alloy castings will be made commercially in this equipment. The furnace is shown in Figure 1.

The chamber in which melting takes place is a water-jacketed steel drum about 5 feet in diameter and 5 feet long. A hinged and water-jacketed door at one end provides access to the interior for loading the crucible and inserting molds. After loading, the furnace door is closed and the chamber evacuated by means of conventional mechanical and oil diffusion pumps to a pressure of about 2 microns. A leak rate of about 2 microns per minute is maintained with pumps blanked off before argon is admitted and melting begun.

Solid Titanium Crucibles For Melting

Since molten titanium will attack any crucible now known except solid titanium, melting is carried out in a shell of solid titanium, known as the skull. This skull is inside a graphite crucible about 18 inches in diameter at the top and 6 inches deep. However, during melting no molten titanium comes in contact with the graphite and hence there is little chance for contamination of the melt with carbon. Recent castings have contained less than 0.06% carbon which is the carbon content of the titanium sponge used as a raw material.

The graphite crucible is backed up by a refractory ramming mix inside a stainless steel shell. A water-cooled copper cover lined with molybdenum radiation shields prevents excessive heat loss by radiation and permits melting a bath of about 50 pounds in a pool about 12 inches in diameter and 2 to 3 inches deep.

Power for melting is fed through three electrodes, each powered by a standard D. C. welding generator. Each electrode can be separately positioned by the furnace operator while the furnace is in operation. The electrode is of negative polarity while the molten bath forms the positive electrode. The tilting mechanism for pouring metal from the crucible into the mold is located outside the furnace. A panel board with all furnace controls as well as indicating voltmeters and ammeters for each electrode is attached to the furnace.

The mechanics of producing titanium castings represent only minor variations of standard foundry techniques. Patterns for split-mold castings are made by conventional methods using a shrinkage factor of about ⅛ inch per foot. Conventional wax or plastic patterns are used for investment castings.

A special refractory slurry is poured over split-mold patterns, allowed to harden and fired to make a strong coherent mold. Investment molds are prepared by dipping the wax patterns into a special refractory slurry, allowing it to solidify and backing it with standard investments in metal flasks.

Molds are given special treatment during fabrication to permit them to withstand the action of molten titanium. Molds are assembled with the necessary gates, risers and pour blocks and held together with appropriate clamps or jigs. Investment molds are dewaxed and fired in standard fashion before use.

After inserting the prepared molds into the furnace and filling the crucible with a sufficient quantity of sponge, the furnace is sealed and evacuated. After blanking off the pumps argon is admitted to the furnace to a suitable reduced pressure for melting.

Each of the three arcs is struck and melting is begun. The furnace operator observes the progress of the melt through sight glasses set in the furnace door. When sufficient metal has been melted the power to the three elecrodes is cut simultaneously and the tilt mechanism actuated by the operator to pour metal from the crucible into the mold set directly below the crucible lip. The molds and the skull are allowed to cool under the inert atmosphere before the furnace is opened. This prevents undesirable reaction of the hot skull and casting with atmospheric contaminants.

Provision has been made in the design of the furnace for reducing cycle time in commercial operation by adding pressure-reducing locks on each side of the furnace through which empty molds can be inserted and filled molds cooled and removed. A port is provided at the top for feeding sponge to the crucible. With only slight modification a vibratory feeder can be installed to feed sponge and alloying elements from a hopper held under vacuum. These modifications

Continued on page 83

2. TENSILE SPECIMENS in titanium, above, have been produced by investment casting techniques.

POWDER METALLURGY

Raw Material In A "Bag"

can relieve inventory problems

By JACK E. LABELLE, Chief Metallurgist, and

PAUL HABER, Product Development Engineer,

Detroit Diesel Engine Div., General Motors Corp.

A bag or barrel of powdered iron compared with a bundle of iron bar stock illustrates an important but seldom recognized advantage of powder metallurgy . . . the simplification of procurement, inventory and stock control.

From bar stock can be obtained a very limited range of pieces. Special contours and shapes demand long-range anticipation and stocking of raw materials. Deviations from the round are likely to be costly.

From a "fluid" material such as a powdered metal can be obtained an unlimited variety of shapes and sizes. Special contours, gears, cams and other conformations all flow from the same hopper. Only the dies and punches are different.

This is one of the factors which have influenced Detroit Diesel to use powdered metal parts for a number of components and currently to consider them for several additional pieces. These factors include:

1. For parts, such as those described here, there is usually an economic advantage from powder metallurgy.

2. Certain properties can be obtained by powder metallurgy not obtainable by other methods of manufacture.

3. Regardless of the size or shape of the part, the raw materials for producing it are available "in the barrel," thus saving the need for large inventories of special bar stock.

4. Because of the nature of the raw material, a definite time advantage can be obtained after product details and production tooling have been worked out, i.e., production runs may be varied to suit the requirements without the delay ordinarily encountered when special shapes, sizes or compositions of bar are needed.

How this works out in practice is illustrated by the following examples, two from current production and two now proposed as powdered metal parts.

Oval Bar . . . A Procurement Problem

Two components having similar functional requirements are shown in Figure 1. They are a balance weight spacer (a) and a blower drive cam (b) which operate as flexible couplings between a shaft and a pair of spring packs (Figure 2) to absorb torsional vibration.

Each of these components was originally machined from oval bar stock, SAE 1118, and hardened. Aside from the expensive machining cycle required to finish these components, one of the most severe handicaps was procurement.

Requirements had to be anticipated well in advance of actual production so that bar with proper section would be available. For a time when special shapes were difficult to buy and delivery was slow, it was necessary to form mill the oval from standard bars. Variations in steels also

of special bar stock

contributed to the problem.

These parts are now in regular production as iron powder parts under General Motors specification GM 3884-M, which is a material having 1 percent maximum combined carbon. Density is specified at 5.7-6.1 gm/cc; ultimate tensile strength 30,000 psi; elongation ½ percent in 1 inch; and yield point in compression 0.1 percent offset, 30,000 psi.

The balance weight spacer is subsequently steam treated and the blower drive cam is carbonitrided.

In both pieces, a substantial saving has been achieved: the spacer cost has been reduced 83 percent, while the cam costs 84½ percent less.

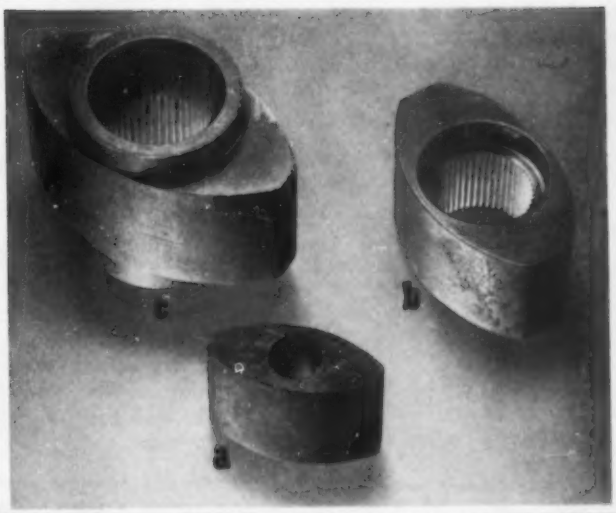
These pieces have been tested for more than 2,000 hours and have shown negligible wear. The powdered iron parts are characterized by better surface working properties, eliminating the need for hardening, and antigalling properties that prevent scuffing when the cam surfaces move against the spring packs.

Design changes have been minor in changing from machined bar to powdered iron. For example, the dimension on the ID serrations of the blower drive cam have been opened up .003 to give .005 limits, but this has caused no change in performance of the part.

A comparison of previous inplant operations with the pow-

Continued next page

1.



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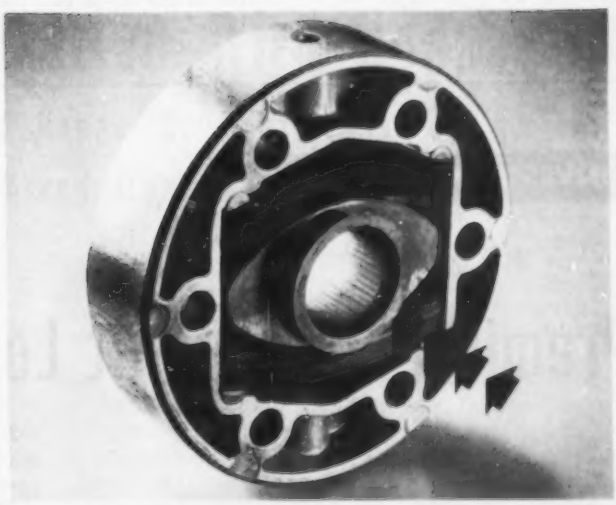

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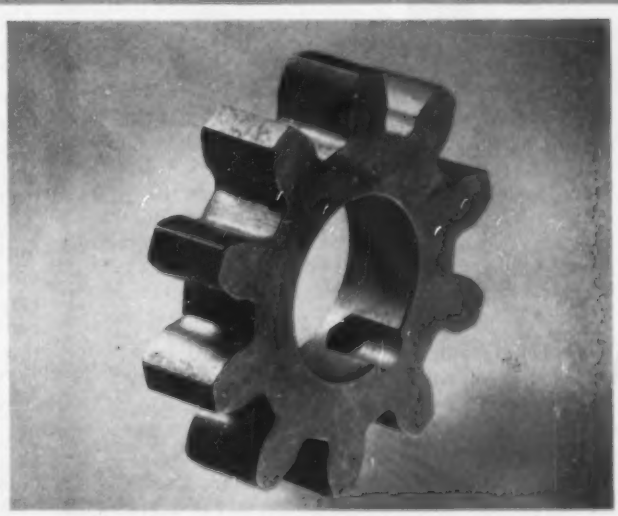


Bag Or Bar? Cont.
dered iron pieces (received ready to be assembled) casts light on the reasons for the great cost reduction:

	Previous Method	*Powder Metallurgy*
1.	Face end, center drill, ream & counterbore, cut off.	None
2.	Chamfer ID on cut off end.	
3.	Burr & inspect	
4.	Wash.	
5.	Tumble & inspect.	
6.	Degrease.	
7.	Carburize & induction harden.	
8.	Draw to required hardness.	
9.	Tumble.	
10.	Broach ID serrations.	
11.	Grind ID to .22" depth.	
12.	Inspect.	

On the basis of present successful use of powdered metal pieces, other machined components are now being reviewed as possible conversions. Two of these are described, together with the expected advantages and economies.

Two components are currently being studied as possible high density iron powder parts, both now being machined from 1144 cold drawn steel bar. One of these is a blower cam similar in function to the two described above, and the other is a fuel pump gear.

Except for being larger in size and having a pair of hubs around the shaft hole, the Model 71 blower cam, Figure 1c, is similar to the other two pieces mentioned above. Its purpose is to absorb torsional vibration. Because of its larger size and heavier duty application, it is proposed that this piece be made as a high density part hardened for wear resistance.

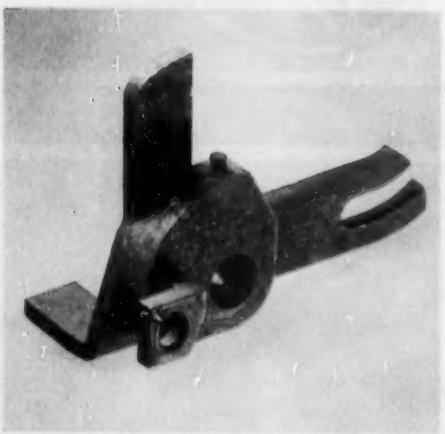
Although cost studies have not (at the time of writing) been completed, it is estimated that a substantial cost reduction should be gained. A big factor to consider is the presence of the two hubs which make necessary extra metal cutting and finishing.

Powder metallurgy will allow greater economy in some places by eliminating machining completely, while in other instances the economy comes about because a simpler, faster and less expensive finishing method is permitted. Thus, on the OD of the hubs, turning replaces

Continued on page 82

INVESTMENT CASTINGS

Premium Material At Lower Cost...



WHEN a component having unusual complexity of shape appears on the drawing board, it pays to look into investment casting as a possible production method. Take an example from current production at Detroit Diesel.

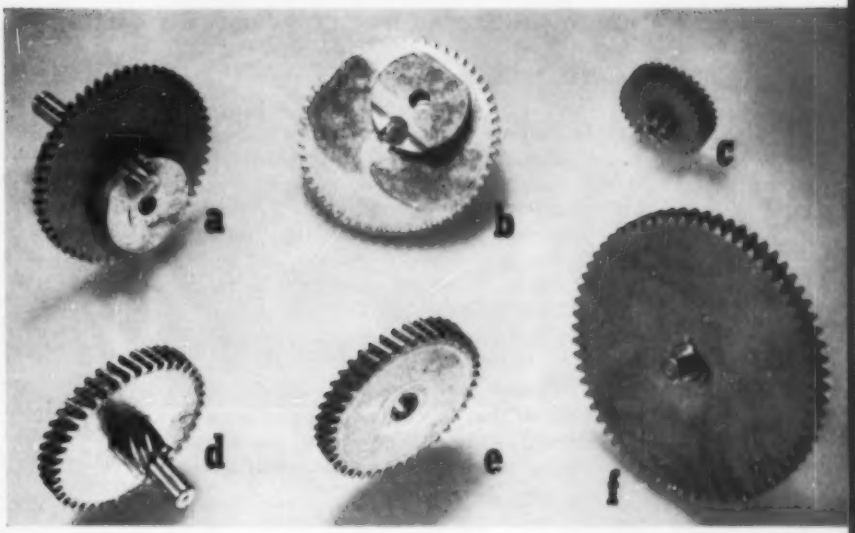
The piece illustrated above was designed originally as an assembly of stampings, but it never was produced by that method because cost studies indicated that investment casting would cost less.

This component is a lever that is part of a vacuum governor system, serving as a link between the governor and the governor control. Almost every surface of this complex little piece is a working surface.

It is interesting to note that it was not only possible to produce it less expensively as an investment casting, but it has also been possible to secure a premium material at this lower cost and also to get a more rigid construction.

Originally the investment castings were produced in SAE 1020, but rate of rejects were quite high. The alloy was changed and it is now cast successfully in a beryllium copper alloy, Berylco 275. This has cut costs by 15 percent because of the greatly lessened rate of rejects.

Present secondary operations are quite simple, consisting of reaming a .3115-.3135 hole, removing burrs, and heat treating to Rockwell C 38-48. Overall cost of this piece, as compared to a finished brazed assembly, shows a saving of about 20 percent.



GEARS AND CAMS that are made from iron powder and infiltrated with copper exhibit greater strength, longer life. See page 42 for details of pieces shown at right.

Infiltration With Copper

Extends Range Of Usefulness Of Powdered Iron Gears And Cams

THE introduction and commercial utilization of the infiltration process in the fabrication of iron base compacts has opened, to the designer and the powder metallurgist, a field which had, hitherto, been uneconomical to exploit. This field is the manufacture of high strength machine components from iron powder.

Two general classes of parts fall quite naturally in the group that now can be made economically; they are gears for moderately high torque transmission and cams that are subject to relatively high pressures with consequent high rates of wear.

Prior to the use of infiltration, these parts could only be made from iron powder by one of the techniques for producing high density, high strength compacts, generally requiring a double pressing, double sintering cycle and usually requiring the use of electrolytic iron powder. Since parts made in this manner are quite expensive, it was less costly to adhere to other methods of manufacture rather than design for or convert to powder metallurgy.

In the manufacture of cut gears, costs are dependent upon the required degree of precision. As tolerances on pitch diameter, concentricity and tooth shape are tightened, costs increase. More expensive initial tooling is required, tool maintenance becomes more costly and rejects are more numerous.

When precision cams are to be made by conventional machine shop methods, the procedure is to blank and shave, followed by such machining operations as are necessary. Where relatively high precision is required, tooling costs are excessive since it is generally necessary to maintain at least two complete sets of tools. As in the case of the gears, a high percentage of rejects occurs at final inspection.

In sharp contrast is fabrication of these parts from iron powder. The initial tooling is seldom as expensive as for other methods of manufacture and, if proper tooling is made, the degree of precision and the duplication from part to part is excellent. Rejects are very low and there is essentially no scrap loss. Infiltration of an iron skeleton does, of course, increase costs and, if coining is not practiced, lowers dimensional accuracy. However, if the parts are coined after infiltration, accuracy of dimensions can be maintained within rather close limits.

Typical of the many gears and cams that are today being made as infiltrated iron compacts are those shown above, used by the Signal Mfg. Co. These parts represent both conversion from another method of manufacture and original design for powder metallurgy.

See next page for details of copper infiltrated parts . . .

Here's How Infiltrated Iron Powder Parts Perform . . . cont.

Combine A Gear And Cam

The combination gear and cam assembly shown at (a) was originally a two piece assembly of a cut gear and a cam made by blanking and shaving. The assembly of the two parts was by a knurled section on the shaft. This method of manufacture required expensive initial tooling, had high tool maintenance charges and required numerous jigs and fixtures for the assembly of the two components. The round cam shape was used as an economy measure, not because it represented the most desirable shape.

Assembly costs and operational characteristics made it imperative that this older cam and gear unit be redesigned — the change was to powder metallurgy, using an infiltrated iron compact (b).

By making this change in manufacturing method, the initial tooling costs were reduced, tool maintenance was eliminated, jigs and fixtures for assembly were eliminated, assembly into the final unit, an electric wind shield wiper motor, was simplified. Where before there was an extremely high percentage of rejects at final inspection, there are now substantially none. The modified cam shape now gives the operational characteristics that are most desirable at no extra cost in either tools or scrap losses and finally, as the gear and cam unit is received from the American Sintered Alloys Division of Engineered Plastics, it is ready for installation in the motor without machining prior to assembly.

While cost comparisons of the final part, ready for assembly, are not known due to the change in design, it is known that the infiltrated iron powder gear and cam piece costs 35 percent less than the older gear and circular cam before assembly. How much the improved design has lowered assembly costs is not known, but is believed to be considerable.

Finally, there is the question of service life that must be considered whenever such a conversion is made. No life tests have been completed, but service tests have indicated that the new gear and cam piece will have at least as good and probably better wear characteristics than the older steel parts.

Cluster Gear

The successful conversion of the part described above led, of course, to the examination of other parts in the motor that would also show a cost reduction by such a conversion. At the present time, the cluster gear (c) is being tooled for this change. As presently manufactured, the helical gear is cut from fibre and into it the steel pinion must be pressed. All of the high cost tooling and costly jigs and fixtures that are inherent in such a manufacturing operation will be eliminated and the part will be delivered ready for installation. Precise cost savings are, of course, not known as yet.

Helical Gears

In addition to the windshield wiper motor, the Signal Mfg. Co. also makes two lines of floor polishers and scrubbers. The smaller of these two units is an all-purpose device that, with attachments, can be used as a polisher, buffer, drill, sander, etc.

In such a unit, weight is important and yet sufficient torque must be delivered at the output shaft to do all of the many jobs required. A 1/10 HP, 16,000 RPM motor is used and is geared down to a final output of 650 RPM, with, of course, a proportionate increase in torque. To accomplish this speed reduction, the gearing (d) is used. Each unit has two pinions and two large helical gears with a 5:1 reduction per pair of gears.

Gears for service in a unit such as this one must be able to transmit the full torque developed by the motor at all speeds from 650 RPM to stalling. In addition, they must withstand shock loading that can come when the unit is running free and a load is suddenly applied. As originally designed, these gears were machine cut from low carbon steel. The helical pinion and shaft are a single unit pressed into the larger helical gear.

By converting the large helical gear to an infiltrated iron powder compact (e), made by Merriman Bros. Co., a manufacturing cost reduction of over 30 percent has been achieved. The pinion is still machine cut and pressed into a cored hole in the gear.

Wear of the powdered iron gear has, thus far, been no problem and it is expected that these gears will show a considerably longer life.

Spur Gear Costs Cut 2/3

On the larger scrubber and polisher unit, four spur gears of the type shown at (f) are required. In this case, the original design of the unit called for the manufacture of these gears by powder metallurgy. As in the previous cases, these are iron compacts infiltrated with copper and are made by both Merriman Bros. Co. and the Presmet Co.

In this unit, which develops a considerably higher torque than the all-purpose unit described above, the powdered iron gears are being made for 1/3 the cost of cut gears. One of the factors that goes to make this great cost reduction can be seen in the method of fastening the shaft into the gear. As can be seen in the illustration, the hole instead of being round has a flat on one side. The shaft is made with a corresponding flat and is designed so that the gear rests against a shoulder. With the shaft pressed into such a hole, twisting is impossible and a simple staking operation holds the gear against the shoulder to give a strong positive drive and lock. Ordinary machining methods would require drilling and broaching to achieve this same method of assembly.

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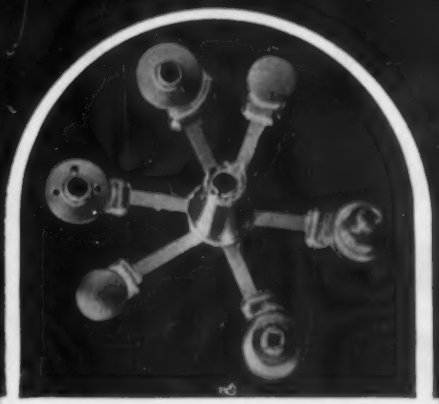

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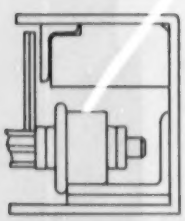
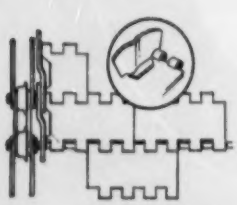


Construction details of "skirt" which prevents entry of foreign matter and protects side chains.



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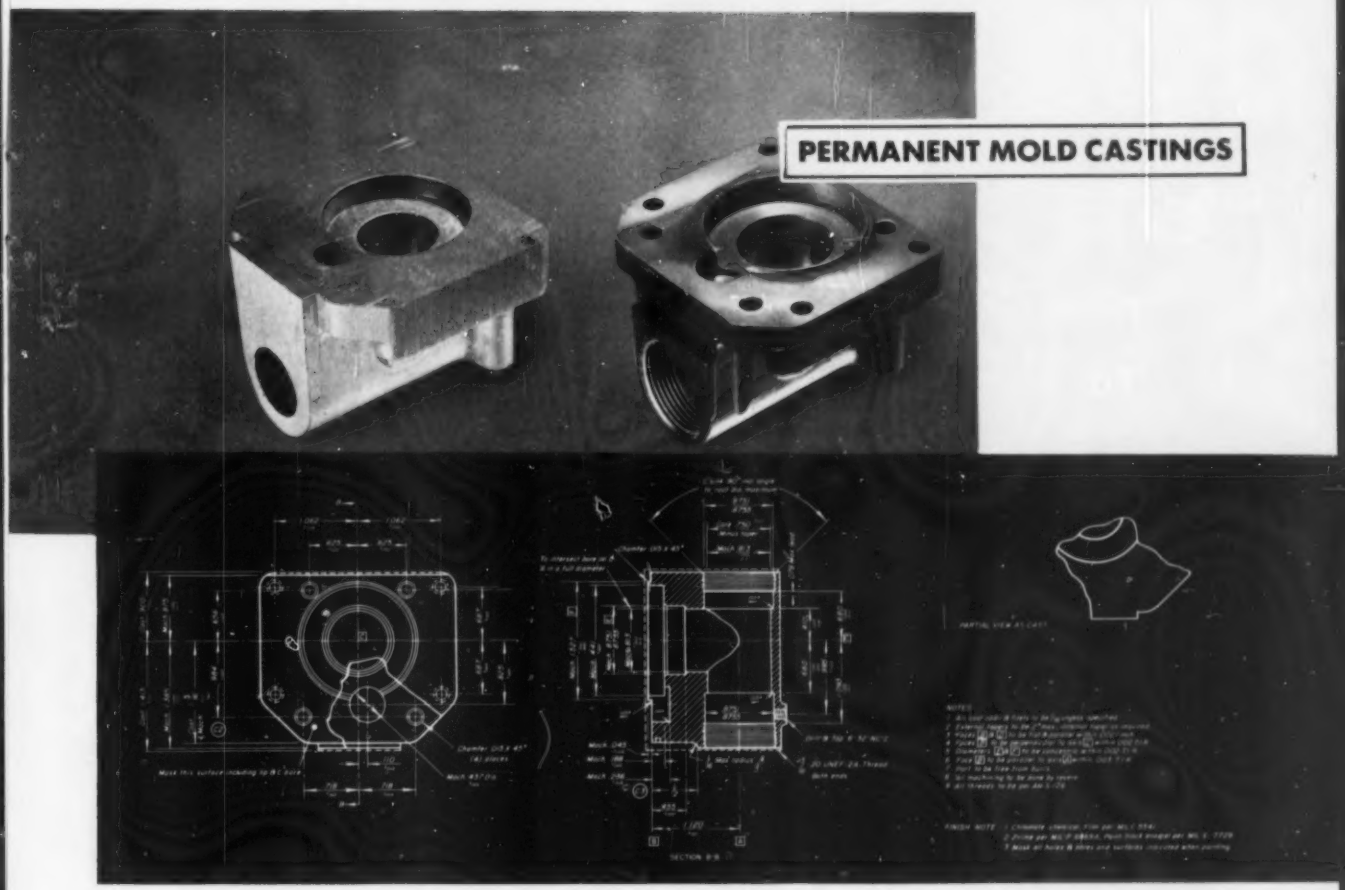

Heavy Machining Calls For Sound Sections

BY A. E. SCHELLSCHMIDT,
Assistant Chief Engineer
Revere Camera Company

THE aluminum gear housing made for the Revere Camera Company by Casting Masters is an excellent example of the reasons for using a permanent mold casting, even though much machining must be done after casting.

This part, illustrated above, is a component of the elevator trim tabs on military aircraft and hence must meet stringent government specifications.

By its very nature, permanent mold casting gives a part that has a relatively fine grain structure and more importantly a uniform structure throughout the casting. There is, of course, a chilled skin, but this skin is very thin so that its presence or absence makes little difference as far as performance of the part is concerned.

From the before and after view above, some idea of the amount of machining that must be done on the casting can be determined. It is, of course, immediately apparent that any porosity in the casting would result in severe oil leakage. The actual details of machining are better appreciated from the drawing. Here are given both the as-cast and machined dimensions and indicate even more clearly the large amount of machine work done.

Finish on the machined surfaces is important. This again points up a major advantage of the uniform and fine grain structure of a permanent mold casting, which helps to achieve the required finish.

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To: D.D.C. Sales Engineers

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INVESTMENT CASTINGS

How Weight Reduction Equals Cost Reduction...

REDESIGNING a machine component for manufacture as an investment casting, in addition to lowering costs, can and often does result in a superior product as a bonus. The split nut on the Lead Screw Tapping Head made by Automatic Methods, Inc., of Elizabeth, N. J., demonstrates this.

The original design of this part, top right, called for machining the nut from phosphor bronze bar stock. Even with the minimum amount of machining, scrap losses in chips amounted to more than 52 percent of the original piece of stock.

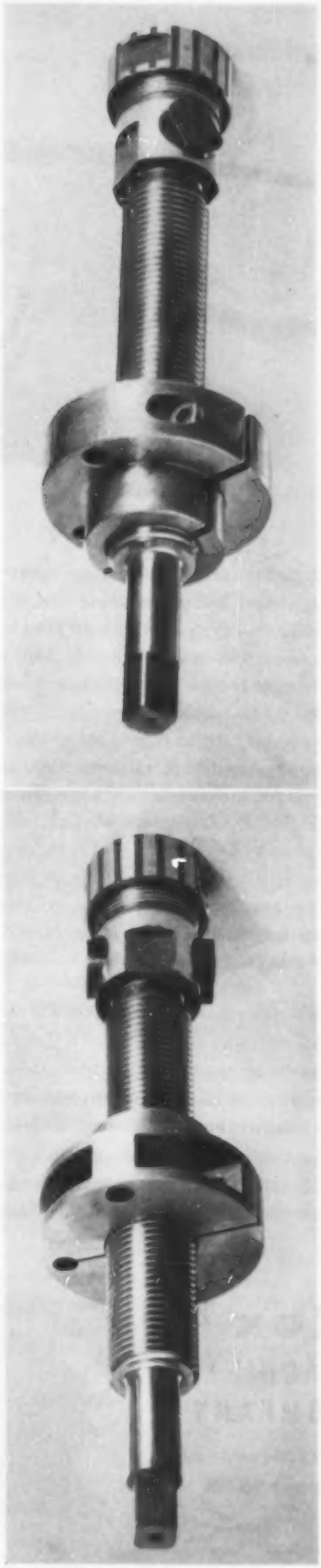
In addition to the high scrap loss, manufacturing procedures required the use of expensive jigs to locate properly the four holes that had to be drilled, one of which required tapping.

By conversion to an investment casting, below right, almost all scrap losses are eliminated. The reduced diameter section is cast to shape and all holes are cored. This change accounts for most of the saving of metal. In addition, cored recesses have been introduced to reduce the weight of the nut still further. The resulting, finished part weighs 12½ oz. as compared to the 16 oz. for the machined nut.

Without considering any other cost differences that may exist, there is a large initial saving in metal costs. The metal for the cast nut costs only 18 percent as much as the material used for a fully machined nut.

Other savings have also accrued from this change. The foundry, Arwood Precision Casting Co., has been able to core the three small holes, eliminating the need of a special jig and the drilling operation. On the older nut, not only did the hole for the clamp screw have to be drilled and tapped, but a counter-bore had to be cut to provide an adequate recess for the screw head. In the cast nut, the recesses cored to reduce weight automatically provide the recess, eliminating still another machining operation.

All of these results were expected and formed the basis for the change to investment casting. As a bonus, however, it became possible to use a somewhat different alloy that has better bearing qualities, resulting in improved performance of the lead screw assembly. The methods employed for reducing the final weight also resulted in a far better appearing part, an item of importance even in such utilitarian products as machine tools.



A SCRAP LOSS of about 52 percent was one cost factor in machining the split nut, shown at the top, from phosphor bronze bar. The investment casting, below, is cast close to finished size.

EVERY NUMBER LEGIBLE because of die cast print wheels ...SO

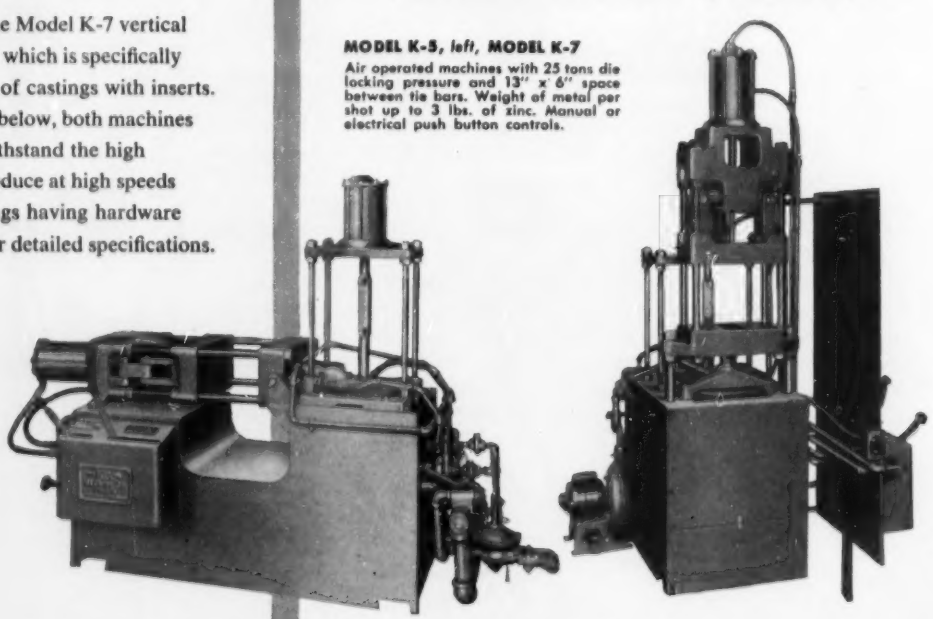
The mechanical brain of a Burroughs Corporation business machine cannot afford mistakes . . . every number must print in perfect alignment and be clearly legible. Helping Burroughs provide this unerring accuracy are radially cored die cast print wheels containing the numbers. These small print wheels, requiring machine tool precision and close tolerances, are made on KUX die casting machines. KUX machines were chosen because they can be depended on for casting parts of exacting dimensions with fine detail. Burroughs says production of print wheels has increased, "AND A BETTER PRODUCT IS OFFERED MORE ECONOMICALLY."

The wheels are cast on the Model K-7 vertical type center shot machine which is specifically designed for production of castings with inserts. Like the Model K-5, left below, both machines are massively built to withstand the high pressures required to produce at high speeds small, solid, dense castings having hardware quality finishes. Write for detailed specifications.

Burroughs chose Kux die casting machines

for production of these finely detailed parts

MODEL K-5, *left,* **MODEL K-7**
Air operated machines with 25 tons die locking pressure and 13" x 6" space between tie bars. Weight of metal per shot up to 3 lbs. of zinc. Manual or electrical push button controls.



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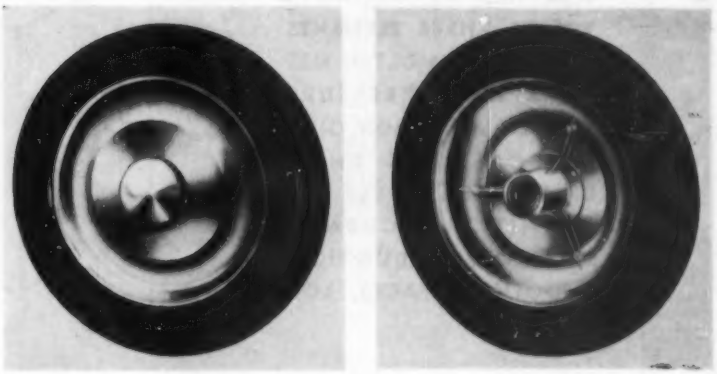
This new design of a standard unit that was conventionally made of steel stampings, leads to the question . . .



Why A Die Cast Wheel...?

The demand for better and lighter wheeled goods by consumers and industry has grown out of today's need for increased mobility and convenience. As a result, the most modern metal working methods are now being used to mass produce that ancient device . . . the wheel.

Die cast aluminum wheels have many advantages over conventional stamped steel wheels, and have gained great popularity. Buyers of wheeled goods prefer them because they are lighter and give superior performance; manufacturers of wheeled goods prefer them because they also simplify production.

Here is a review of features embodied in a new line of die cast aluminum wheels, produced by National Die Casting Co. that was developed for the Nadco golf cart.

Strength: One characteristic of the die casting process is the ability to "place metal where it is needed" and eliminate it where it is not needed. This permits the wheel designer to use stiffening ribs around the hub, where needed for structural purposes, without increasing the general wall section. To gain equivalent strength from sheet metal, heavy gauge material is required. Stiffening ribs can only be added to sheet metal by means of costly additional forming and assembling operations.

Weight: The weight of a die cast aluminum wheel (due both to the lower specific gravity of the material and the thinner sections possible) is about ⅓ that of a stamped wheel of equivalent strength. Reinforcing ribs are easily included in the die casting to permit the thinner, lighter design.

Serviceability: Aluminum does not rust; in fact, the oxide coating that forms immediately upon exposure to air is a hard, colorless and durable surface. This factor, in itself, gives to the die cast wheel an immediate advantage over its steel counterpart. While aluminum can be anodized, painted or chemically treated to give an attractive or protective coating, it is not essential. Bare, uncoated aluminum has proved to have excellent consumer acceptance. Steel, on the other hand, must be protectively coated and requires regular maintenance.

Where wheels may be subjected to special service conditions, it is often possible to incorporate extra features in the die casting which resist excessive abuse, unusual stresses, or other conditions without materially increasing either the tool or piece costs.

Appearance: Not only consumers, but also industrial buyers, have been proved to be susceptible to styling and appearance when making purchasing decisions. Of two products having equal serviceability, the buyer is likely to take the one with the better looks.

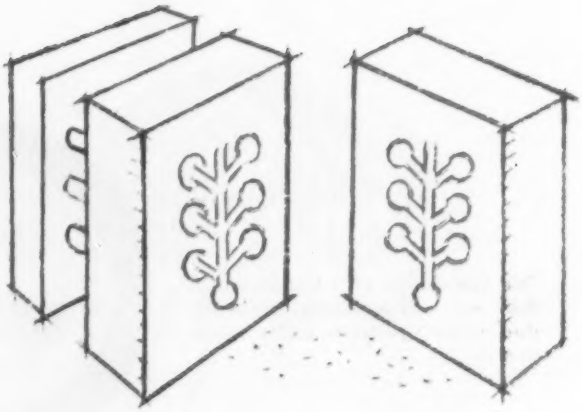
Die castings permit an unlimited range of styling: lettering, ornamental emblems, ribbing, surface treatments and other decorative handling can be readily incorporated. With stamped forms, this is not possible.

Production: To the production engineer, the die cast wheel represents simplification and elimination of processing steps. The conventional wheel has been made by stamping, generally two pieces spot-welded, screwed, riveted or

Continued on page 75

DIE CASTING

MAKING A DIE CASTING INVOLVES THREE ELEMENTS: A STEEL DIE, MOLTEN METAL, APPLIED PRESSURE. THIS COMBINATION GIVES DIE CASTINGS THEIR UNIQUE FEATURES: UNIFORMITY, ACCURACY, SPEED OF PRODUCTION, SMOOTH SURFACES, LOW COST.



1. THE DIE from which millions of duplicate castings are produced, is machined from special steel.

The Die Casting Process

WHAT IT IS Many methods have been developed over the centuries for casting molten metal, but the two specific factors which distinguish the die casting process from all others and give to die castings most of their desirable features are: 1) the use of a *steel die cavity* in which the casting is formed, and 2) the application of *pressure* to drive the molten metal into the cavity.

This combination of permanent die and applied pressure account for the speed with which large quantities of castings can be produced, the close dimensional accuracy, the high quality surface finish, the intricacies of shape that are possible, and the low piece price.

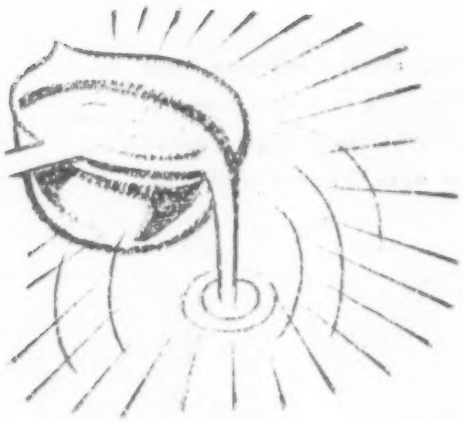
Die casting is the most highly mechanized of casting techniques, since only by the use of complicated die casting machinery can the rapid casting cycles and tremendous injection pressures be accurately controlled and coordinated.

Die casting is generally considered a "one-step process" because the molten metal is converted in a matter of seconds from a fluid, formless mass into a finished or semi-finished component. The actual casting operation can readily be described, as it is below, but the preparation for the first "shot" in the die cavity is a slow and detailed process, starting with the analysis of the piece that is to be die cast, design of the die, construction of the die from expensive special steels, and the production of trial castings.

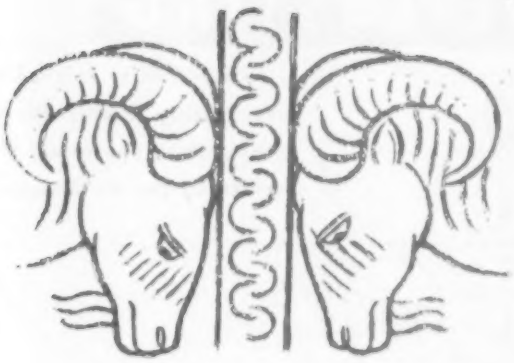
This portion of the process may take several months and require frequent consultation between die designer and product designer. Once the die (which is simply a negative cavity or cavities of the piece) has been designed, built, tested, trial castings approved, last-minute changes made in the die, and the die hardened, the production of millions of substantially identical castings can be carried out rapidly and at low unit cost.

The actual die casting cycle begins with the introduction of molten alloy in front of the hydraulically-actuated plunger inside of a cylindrical "shot" sleeve. As the plunger moves forward, it propels the metal rapidly through a narrow opening into the die cavity. Within a fraction of a second, the fluid alloy surges through the "gates" which feed the cavity, filling out each minute detail and section of the die. Due to the lower temperature of the die, the casting cools quickly, permitting the die halves to be separated and the casting ejected from the cavity in a few seconds.

The two principal sub-divisions of the above process are called "hot chamber", for zinc, tin or



II. THE METAL for die castings must be very closely controlled for purity and composition.



III. THE PRESSURE which distinguishes die casting, is applied behind the molten metal to drive it into the die cavity.

ONE OF A SERIES OF BASIC FACTS ABOUT THE pmm PROCESSES FOR DESIGNERS AND BUYERS

lead alloys, and "cold chamber" for aluminum, magnesium and copper-base alloys. The difference lies in the method of introducing metal into the shot sleeve. In hot chamber, the plunger is submerged in the molten metal and consequently, the melting furnace is an integral part of the die casting machine. In cold chamber, a separate furnace is used, and the metal is ladled by hand into the shot sleeve immediately before each casting cycle.

The two basic die components are the two halves of the die, known as cover and ejector halves, but most dies also have slides, moving cores, collet sections, loose cores or other features which permit the production of more complex components. Without these added features, die castings could only be made when they had no undercuts, side openings, or other conformations that would prevent straight withdrawal of the casting from a simple cavity.

In operation, the cores, slides and other integrated die components work with rack and pinion or hydraulic actuation synchronized with the closing and opening of the die halves.

These added die features complicate the die construction, increase the cost of the die, slow the casting cycle, and multiply the die maintenance problem, but they generally save enough money that would otherwise have to be spent on machining and assembling of the castings to justify their inclusion. Only an experienced die caster can determine beforehand when the cost of such additional die components is justified.

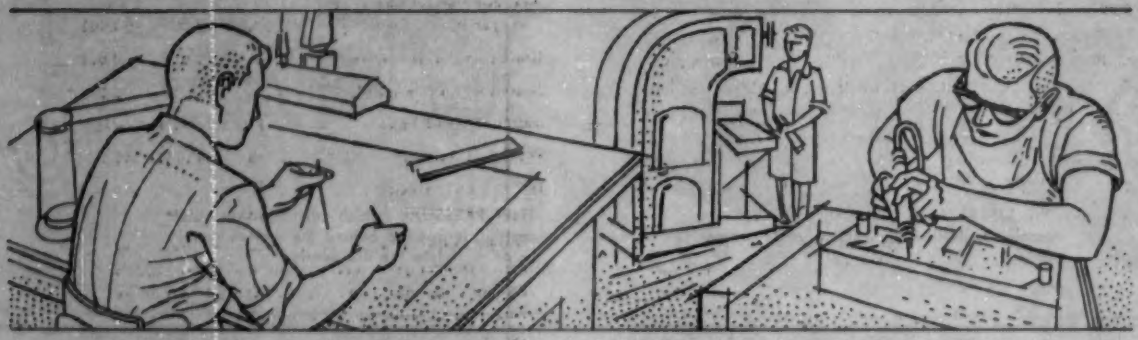
WHEN TO USE IT

Die casting is essentially a large-volume method of production; initial tooling costs can rarely be amortized over short production runs. It might be feasible to devise a formula which would balance the number of pieces and the saving in cost of secondary operations against

Physical Properties
Design Considerations
Metals Used
Typical Application
Some Advantages

DIE CASTING

is called "the shortest distance from raw material to finished product" but the shot that produces the casting is only the climax of a series of highly skilled preparatory operations that begins when the part print is received by the die designer . . .

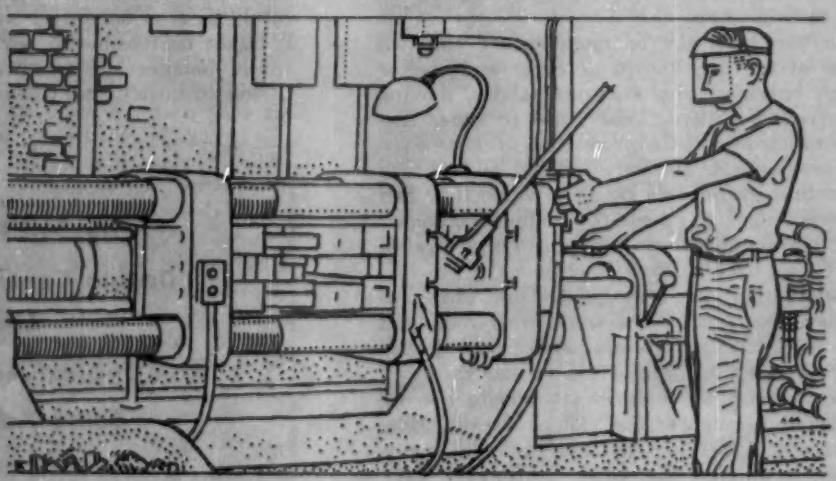


The die designer plans and details the construction of the die to produce a piece which meets specifications for surface, dimension, shape, soundness, after which . . .

The tool room takes over, using heavy machine tools and small hand finishing equipment to build the die from special tool steel. To check the die . . .

Trial castings are produced and submitted for approval. Final corrections and changes are made in the die and it is then heat treated. Production is ready to begin, so . . .

Alloy is melted under carefully controlled conditions to meet very close composition limits. Some alloys are fed automatically into the machine (hot chamber) while others are hand-ladled (cold chamber) . . .



The actual "shot" is a rapid cycle involving application of lubricant, placing of inserts, closing the die halves, injecting metal, removing the gate of castings, and checking visually for gross flaws.

the higher tooling cost so that a convenient answer could be found to this question, "When is it cheaper to use a die casting?"

The first qualification is, of course, whether or not the part *can be* produced as a die casting. This limits the pieces to those whose physical properties, desired surface finish or sales acceptance can be obtained from one of six alloys: zinc, aluminum, magnesium, copper, lead, tin.

The next consideration is whether or not the *shape of the piece* lends itself to die casting. The part must be withdrawn from unyielding steel dies and draft on all sides is required; openings in the sides, top or bottom of the casting must be formed by moving parts in the die; size of casting must not be greater than possible on existing equipment. Tolerances should be open on all but critical dimensions, especially between surfaces formed by moving parts of the die.

A few of these latter considerations are tabulated in Table 1 to help the designer recognize, in a general way, what can or cannot be produced by normal die casting practice. If exceptions to this are made, they should only be done upon the advice of a competent die caster.

When the piece is an exterior component that must have good sales appeal, die castings are readily used because all of the popular commercial finishes are possible, and finishes for corrosion protection have been developed for use on die cast surfaces.

Conditions such as outdoor exposure, resistance to abrasion, moderate stress or special service conditions can generally be met. All of the die castable alloys have been the subject of development work that has resulted in stable, strong, corrosion resistant materials suitable for the majority of applications. Physical properties are well established and engineering characteristics of these alloys can be predicted, as reviewed in Table 2.

ADVANTAGES The advantages of die casting are cumulative; that is, the features which favor the use of a die casting will usually give more than one advantage. For example, a die casting is preferred over a rough sand casting because fewer and less expensive machining operations are required. At the same time, the product designer gains lighter weight, better surface, improved detail and accuracy that helps in assembly.

Probably the greatest single advantage of die casting is the *cost factor*, especially for long production runs of complex pieces needing moderate-to-close accuracy.

But die castings frequently permit other product improvements, production simplification or improved sales appeal. Compare a die casting with an assembly of brazed stampings . . . the die casting will be stronger, more accurate and generally easier to handle in production, as well as lower in finished cost.

Compared with a completely machined com-

Continued next page

Guideposts for Designing Die Castings

Table 1: Design Factors

	Zinc	Aluminum	Magnesium
Ave. commercial tolerance, in. per in.	±0.0025	±0.003	±0.003
Draft on walls, in. per in.	0.005	0.010	0.008
Draft on cores, in. per in.	0.003	0.010	0.010
Depth of cored holes	3 to 8 times diameter		
Wall thickness, min. in.	0.015	0.035	0.035
External cast threads, max. per in.	24	24	16

Note: There is wide variation in minimum and maximum design values, so that the above figures can only be considered typical. Exceptions can be made, as determined by consultation with the die caster.

Table 2: Typical Physical Properties

	Zinc	Aluminum	Magnesium
Tensile strength, psi as cast	41,000-47,600	30,000-46,000	29,000-38,000
Elongation, % in 2 in. as cast	7-10	1-9	1-5
Weight, specific gravity, ave.	6.65	2.8	1.8
Charpy impact str., ft-lb. as cast	43-46	2-8.3	0.5-3

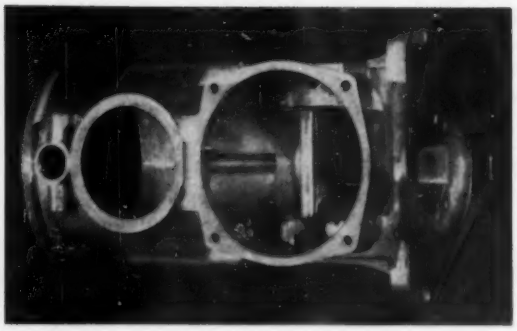
Based on data from New Jersey Zinc Co., and Aluminum Company of America

Table 3: Some Comparisons

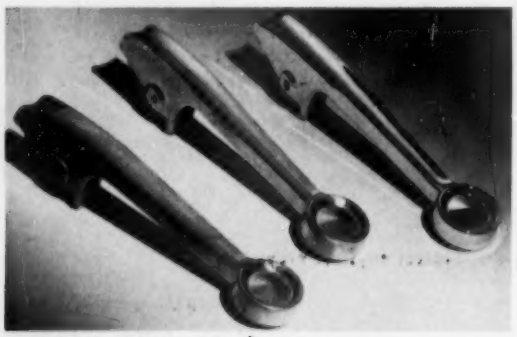
	Die Cast	Sand Cast	Stamping
Tooling cost	High	Low	High
Piece cost	Low	Medium	Low
Machining cost	Low	High	
Shape possibility	Complex	Medium	Simple
Surface appearance as formed	Excellent	Poor	Good
Accuracy	Excellent	Poor	Good
Wall sections	Varied, thick and thin	Thicker	Uniform

The List Of Industries Using Die Cast Parts Continues To Grow...

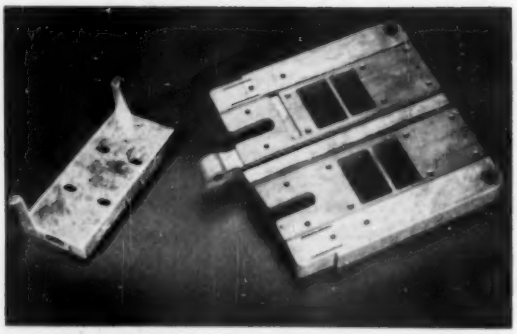
Few industries today are not making use of the die casting process for components. These range all the way from non-functional decorative trim, to heavy duty power transmission elements. As designers face the difficult job of combining low cost with high quality, they will introduce more and more die castings into their plans.



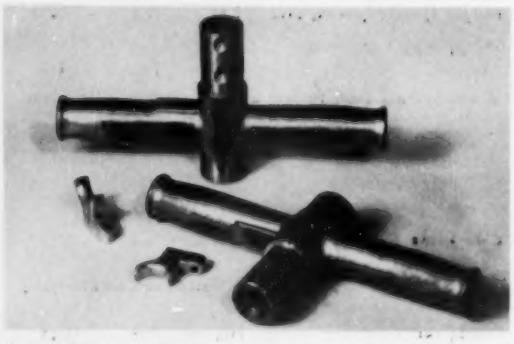
Aircraft



Appliances



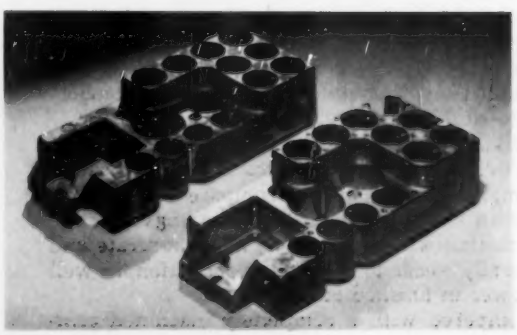
Business Machines



Auto Accessories

Sporting Goods

Special Purpose Machines



Radio and Electronics

ponent, the die casting is very often less expensive, consumes very little production time or equipment, results in no scrap loss in chips, is likely to be lighter, and may have features which would be impossible or impractical by conventional machine shop methods, such as odd-shaped blind holes.

Compared with molded plastics, die castings have the obvious advantage of greater strength and stability, provide more secure anchorage for screws and other fasteners, and are generally superior in durability.

Inserts of other materials can readily be placed in the die cavity and permanently assembled into the casting when the molten metal flows around it. This is used to incorporate stiffening materials such as steel; bearing materials such as brass; non-metallic materials such as paper or cloth; functional materials such as magnets; electrical materials such as core laminations; or conduits such as copper tubing.

Die castings permit the *most economical fastening* methods: self-tapping screws, spring-type fasteners, screw thread inserts, drive pins, self-riveting, spinning and staking. It is possible to core holes and cast bosses accurately on centers and diameter, so that assemblies go together with a minimum of hand fitting.

Machining of die castings is common, since die castings reduce, but rarely eliminate machining operations. However, the extent and nature of these *machining* operations *is much lighter* on die casting.

Die castings are well *adapted to the bulk finishing processes:* barrel finishing, automatic polishing and buffing, continuous line chemical treatment or painting. They also permit the use of such labor-saving devices as electroformed paint spray masks for selective painting.

One of the greatest features die casting has to offer, from the viewpoint of product stylist, is the *freedom of shape* permissible and the unlimited range of surface ornamentation that can be introduced at very small increase in tooling or finishing costs.

METALS The sharpest restriction on the use of die castings comes about through the limited range of die castable metals, as listed previously. However, through extensive research, and close quality control during production of alloys and castings, maximum physical properties are secured. Furthermore, current work is being done to increase the life of die casting dies for high temperature die casting alloys, which may permit more extensive use of brass and bronze.

The selection of the proper alloy is, again, a matter to be discussed with the die caster, although certain qualities such as lightness, ductility, plateability, etc. will determine whether an alloy based on zinc, aluminum or magnesium is to be used. The specific alloy of the metal will be selected on the basis of castability, desired surface appearance, type of finish to be applied, service conditions or shape of the piece. For example, a silicon alloy of aluminum having high fluidity may be needed where thin, intricate sections are involved, but a silicon-free aluminum alloy if an anodized finish is specified.

COST Low cost of a die casting is the factor which is most often responsible for using this type of casting. Due to the high-speed, low-labor-consumption, high-accuracy characteristics of die casting, the end cost of a finished die casting will be relatively low.

Initial tooling cost is high because of the intricate dies made of special tool steel, and the large amount of skilled labor required to design and build such dies. Capital investment of the die casting facility is also high. However, where production runs are long and an appreciable degree of complexity or precision are indicated, die castings are the most economical.

APPLICATIONS Where are die castings being used? The question of where they are *not* being used would be easier to answer. The biggest single industrial usage of die castings is in the building of automobiles. Die castings go into every part of the modern car: decorative trim, fuel system, ignition system, functional hardware, chassis, grille, cooling system, window operating mechanism, trunk hardware, brake system, etc.

In home appliances, the story includes: sewing machines, washing machines, vacuum cleaners, refrigerators, fans, freezers, air conditioners, driers, polishing machines, waste disposal units.

The aircraft industry finds use for a large assortment of die cast parts, principally aluminum and magnesium because of the weight factor: electrical fittings, hydraulic housings and components, instrument housings, chair seat hardware, pilot ejector mechanisms.

Industrially, die castings find their way into every conceivable type of special machine, those intended to knit or weave cloth, evacuate radio tubes, blow glass, manufacture shoes, roll cigarettes, package food, drill holes, produce printing, process chemicals, form pottery, measure gasoline, saw wood or fill milk bottles.

Business and vending machines, likewise, use millions of die cast pieces each year, for housings and frames, decorative trim, and working parts of typewriters, calculating machines, adding machines, time clocks, vending devices, games of skill, music players, drink dispensers, cigarette machines, dictating equipment, etc.

Among the other industries, too numerous to list completely, which have major applications for die castings in one or more alloys, are: radio and electronics, agricultural equipment, builders hardware, textile findings, lighting fixtures, outboard motors and small gasoline engines, photographic and scientific instruments and toys.

While the tonnage of die castings used in the auto industry will not decrease, the percentage of other uses for die castings will steadily increase, as they have over the past several years. Tomorrow, few industries will not use die cast components for some part of their products.

"Clinics" To Help Designers Of Die Castings Scheduled By Jobbing Die Casters

Jobbing die casters throughout the country have entered into a new informational program to show American industry how better metal components, produced by die casting, can meet the squeeze of high costs and high quality output. The new program has been announced by David Laine, secretary of the American Die Casting Institute, national association of job shop die casters.

The basis for the program is the feeling that many segments of American manufacturing industry have not fully recognized the importance of experience and "know how" in producing high quality die castings.

The purpose of the new informational program is to acquaint design engineers and production executives at every industrial level throughout the country as to: (1) the full potentialities of the die casting process; and (2) the necessisty of knowing the "art involved in the die casting process." According to Mr. Laine "you just don't buy a die casting machine and start producing". Many years of experience are required in part design, die design, die fabrication and machine set-up.

One of the first steps in this informational program, is the showing of the American Zinc Institute film "Die Casting — How Else Could You Make It" to special industrial groups throughout the country. These showings will be given either directly under the auspices of the regional sections of the American Die Casting Institute, or in cooperation with local branches of national technical societies and industrial groups, and at special groups arranged by local industries.

Wherever the film is shown, technical commentators and special exhibits of die castings will accompany presentations of the film. Pointing out that these sessions will not be "propaganda" for the American Die Casting Institute, Mr. Laine emphasized that the technical commentators' sole function will be to answer technical questions.

In addition to these special film showings, the ADCI plans various local conferences to discuss design problems in die casting. At such sessions technical men from use and potential user companies will be invited to gain information as well as to discuss specific problems.

Mr. Laine revealed that these meetings will feature "clinics" at which designers can bring in component and part design problems. The technical commentators will encourage the use of die casting only for valid applications. According to Mr. Laine, "we will be the first to urge some other production process, rather than see a bad die cast product on the market."

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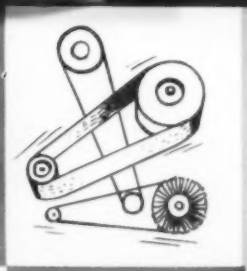
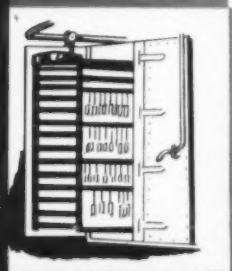
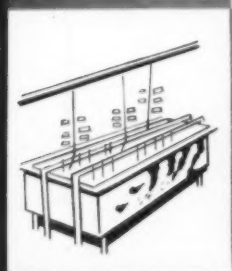
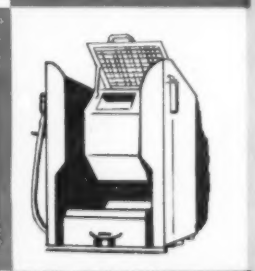



PMM

Finishing Section





Finishing includes all secondary operations performed on precision metal molded parts — up to and including final surface treatment. This section presents new information about the specialized methods, equipment and materials needed for finish-machining, assembly, surface preparation and final finishing of all precision metal molded parts.

devoted to the specialized problems of finishing . . .

DIE CASTINGS • INVESTMENT CASTINGS • PERMANENT MOLD CASTINGS • PLASTER MOLD CASTINGS • POWDER METAL PARTS • SHELL MOLD CASTINGS

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Screws can be "trouble-bent" in many ways. Most thread faults like those listed here are invisible, but their effects (job slowdown, parts spoilage, high reclamation expense, hidden weakness) show clearly in assembly costs and customer complaints.

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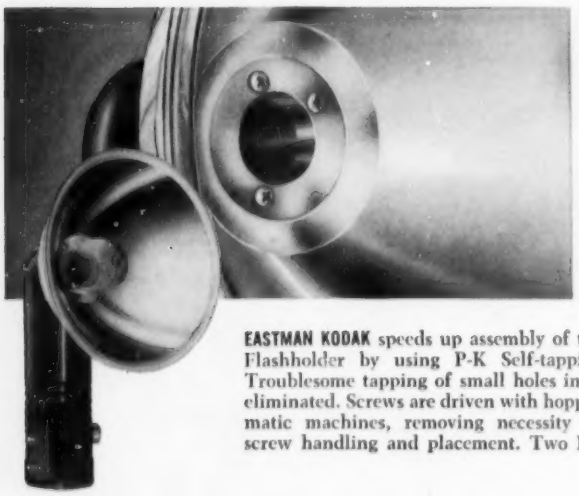
For information on any fastening problem, talk to a P-K Assembly Engineer. Parker-Kalon Division, General American Transportation Corporation, 200 Varick St., New York 14. Chicago Warehouse, 4331 West Lake St., Chicago 24.

IS DIAMETER OFF-SIZE?
— means hard driving
— breakage
— weak fastenings
DO THREADS STOP SHORT OF HEAD?
— means loose screws
ARE THREADS RAGGED and SEAMED?
— makes driving difficult
ARE THREADS TOO SOFT?
— means spalled threads
ARE THREADS TOO HARD?
— means stripped threads
IS POINT (on Sheet Metal Screws) BLUNT?
— makes starting difficult

P-K STANDARDS PROTECT you against the thread faults illustrated and many others that will cause assembly trouble and weak fastenings. They don't "get by" P-K inspectors—that's why *all* P-K Self-tapping Screws can be "Guaranteed First Quality."



EASTMAN KODAK speeds up assembly of the Kodalite Flashholder by using P-K Self-tapping Screws. Troublesome tapping of small holes in plastic was eliminated. Screws are driven with hopper-fed automatic machines, removing necessity for tedious screw handling and placement. Two P-K Phillips Head Type F Screws fasten a cover mounting bracket to the flashholder case (right) and three more fasten the metalized Tenite II reflector to the case (left). Case is a thermo-setting phenolic. Screws hold firmly under all stresses of normal use, can be removed for attachment of new reflector.

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READY FOR COATING, the semi-finished casting on the left will pass through the cycle outlined on the following pages. Casting at right has been coated, and is ready for final machining.

Seal - Protect - Enhance With One Coating

By **E. J. SOLSKI,** Chief Methods Engineer
A. P. Controls Corp.

A NUMBER of methods of sealing die castings that have proven to be emminently satisfactory. All of them, of course, depend upon filling the porosity with some material that is impervious to the fluid in contact with them. Among the commoner materials in use are sodium silicate, thermosetting plastics, and metal oxides. All of these materials are useful in certain applications.

A. P. Controls Corp. of Milwaukee recognized the need of a good corrosion-resistant finish in the inside of oil control valves on oil burners which would be impervious to action of water, acids, sulphur and other contaminating factors. The finish had, further, to seal minor porosity and to furnish a pleasing appearance on the outside of the valve.

A completely satisfactory finish was finally found in a new vinyl plastic coating. Some of the problems that faced the engineers charged with the selection of the material and the design of equipment for applying it:

1 The process had to provide a fast, efficient method to etch, clean and properly bake the die castings, which had to be free of any deposits and the casting surface had to be properly etched to provide a good sealing bond.

2 The method had to provide cooling of the casting to correct temperatures so the pores of the metal would readily absorb the vinyl plastic coating.

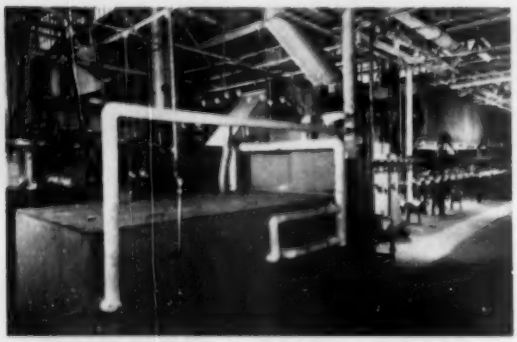
3 Provision had to be made for a final cure which would drive out volatiles without creating bubbles or blisters in the finish, either inside or outside.

After consultation with various manufacturers of conveyorized and batch type equipment, preliminary layouts were made which provided a solution to all of the problems, at this point Despatch Oven Co. was asked to design, fabricate and install a hook type continuous conveyor within the limited space available. A chain conveyor keeps the castings moving at an even pace through each step of the process. Proper spacing of the treatment areas was necessary so that one step could be completed before the oil control body moved to the next. This required careful planning so that

Continued next page

Follow These Valve Bodies Along The Finishing Line...

Four Logan lathe operators face and trim raw die castings at the start and a worker places the castings on the conveyor hook. At the right is seen the control panel for the entire system. Drying ovens are directly above the machining area.



Machined and racked castings go first into the cleaning and etching tank (foreground). Etching is done in "Chem-Bond" at 140F, then the parts are spray rinsed twice with warm water and then with "duo-rinse" at 180F. Between the etch and the final rinse the castings must be kept moist to prevent the formation of spots. Drying is done in an air oven at 145F.

Hot parts go directly from the drying oven into the coating tank held, nominally, at room temperature. Cooling of the parts in the coating tank causes the pores to shrink and thus firmly grip an adequate amount of vinyl plastic to seal the pores completely. Note the angle of entry of the conveyor that is required to give proper coating. The plastic coating used is Cordo-bond R-149 formulation and the thinner used to maintain the proper viscosity is P-371 formulation.

Solving Production Problems In Applying Vinyl Plastic—Cont.

timing, speed and temperatures were accurately controlled and maintained.

Other problems included the etch-wash tank, neutralizing rinse, a dry-off oven, hooks to hold the oil control casting at exactly the correct angle during the dipping and drying process so that no drip-bubbles remained on the part and provision for complete coverage of all areas.

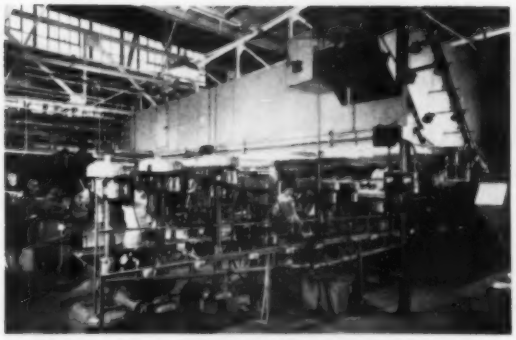
A two-temperature curing oven was designed to give the proper pre-drying and curing of the coated castings.

Naturally, as warm work entered the dip tank, and slowly raised the temperature, there was a problem of control of the vinyl plastic so that it would remain in proper condition for coating. Solution of this was found in viscosity control of the liquid vinyl plastic. Periodic checks are made on viscosity with a #2 Zahn cup and it is maintained at 30 seconds by additions of slow and fast thinners.

Some of the smaller details that required solution seem unimportant, but actually are of prime importance in the successful operation of the system. For example, in the etch, rinse, and coating tanks, small air bubbles had a tendency to adhere to the surface and prevent adequate cleaning or coating. Solution to this problem was found by providing a series of trips in the tanks. As the castings pass through they bump the trips and the bubbles are dislodged.

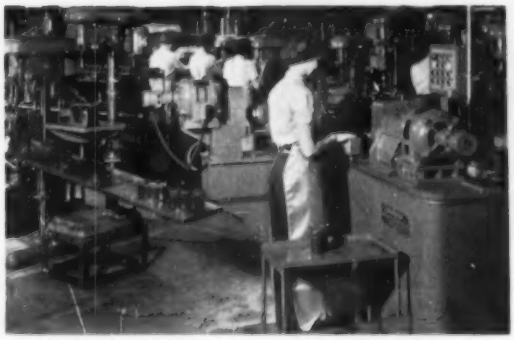
Another problem was in securing proper coverage and drainage. Here the solution was found in three factors: 1) the rate of withdrawal, 2) in the design of the hanger and the manner in which the castings are racked, and 3) the proper blend of slow and fast thinners for full stripping of excess vinyl from the casting.

When all factors are in proper balance, the castings are com-



From the coating tank the bodies pass directly into the two zone curing oven with the first zone at 125F and the second zone at 200F. The dual temperature cure prevents blistering of the coating due to subsurface solvent being released after a tough skin has formed.

Leak testing the finished castings. In service the main body of this casting must stand about 5 to 10 psi while the strainer section must stand 90 psi, both pressures gauge.



Final machining is done after coating. Surfacing, drilling and tapping may be done at this stage. The coating is tough enough and adheres well enough so that machining can be done with no danger of chipping or peeling.

pletely coating and drain so as to leave a vinyl plastic film over the entire body of uniform thickness. So well has this particular problem been solved that tears form in only a single place, where a clean-up cut in the form of a "V" groove must be made after coating. This clean-up cut automatically removes the single tear that sometimes forms.

Indicative of the careful design in the equipment is the installation of a CO_2 fire extinguisher system through all portions of the equipment where the highly flammable solvent is present. At this time, no solvent recovery system is installed, but such equipment is planned for the future.

Tied in with the sealing and finishing system is a leak testing set-up. Here, again, a departure has been made from the usual system of testing. Experience has shown that the use of compressed air in a water bath, with or without either soap or a wetting agent, did not locate all leaks or allowed very small leaks to go undetected. An air pressure system using mercury manometers was devised for testing. Under test, the oil control valve bodies are subjected to air pressure of about 32 inches of mercury. The rate of pressure decline, after the system is sealed off, is noted and any departure from the normal is indicative of a leaking casting.

Because several different components go into the oil control valve, all of which must be coated to match, and all of which may be of different materials; the system had to be made highly flexible. As finally developed, parts made of zinc, aluminum and steel can be coated in the same equipment simultaneously and, in fact, it is quite usual for intermixed parts to go through the coating system.

The only limitation that the coating system imposes is in the type of zinc alloy treated. Experience has shown that only a zinc die casting alloy with a low copper content can be cleaned and etched to produce satisfactory coating adhesion. All zinc die castings that are to be coated, therefore, are specified in ASTM B-86-46, No. XXXIII.

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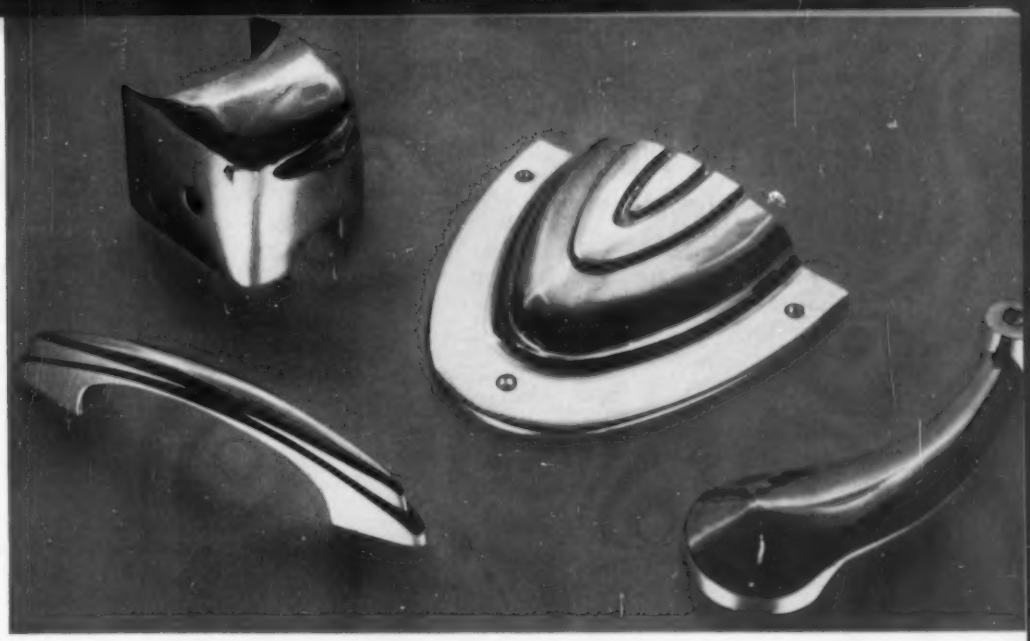

CHROMIUM-PLATED aluminum die castings shown include both production jobs and test samples. High quality plate is evident.

Methods of Plating Aluminum Die Castings

By LYNN SPRAGUE

THE electroplating of aluminum castings is a science which has been neglected for production items until recently.

Technically, there are three reasons that aluminum has been difficult to bond plating materials to. First of all, aluminum forms an adherent, hard, brittle oxide film instantaneously upon exposure to air or oxidizing solutions. Early attempts were made to plate over a deliberately formed oxide film. Unfortunately, only a mechanical bond was formed due to the porosity of the oxide film. It was found to be absolutely necessary to remove this oxide-barrier for truly successful adherence.

The extreme activity of aluminum with certain solutions such as strong alkaline solutions rendered it susceptible to attack by the plating solutions. The reactions are generally accompanied by a smut formation due to the alloying elements present. The smut prevented satisfactory adhesion of the plating material.

Fortunately, aluminum not only has an affinity for oxygen but is anodic with respect to most metals, particularly the common ones such as iron, chromium, copper, nickel, and zinc. Due to the anodic behavior of aluminum in solutions containing metallic salts, the aluminum will replace the metallic ions of the more noble metals. This is the basic principle of the zincate immersion by means of which most aluminum castings are plated.

Alternate means of surface preparation such as phosphoric acid anodizing and sulfuric acid anodizing will be discussed in detail.

The other leading technical difficulty in using aluminum as a base metal is the large number of alloying elements used in aluminum alloys which result in various micro-structures. The alloying elements may be carried in solid solutions or as a fine dispersion of intermetallic compounds. The microstructure will vary also with the heat treatment applied. Each variation in the structure of these alloys will create varying chemical and electro-chemical reactivities which will present various states of reaction across the surface of the die casting.

Surface Preparation

The initial stage in the surface preparation is the polishing and buffing to provide a mechanically smooth surface. Care should be taken in the choice of a buffing compound in order to assure that the compound can be fairly easily removed. Electrolytic cleaning cannot be used successfully on aluminum due to the rapid attack by alkaline agents in electrolytic cleaners.

The polishing and buffing operations are easily held to a minimum because of the smooth surface of die castings, the ease with which aluminum is cut by abrasives, and the flowing characteristics of aluminum. In general, buffing compounds are best

Continued next page

Preparing The Surface For Electroplating

selected by experimentation and consultation with the vendors of buffing compounds.

The bulk of the buffing compound, residual drawing compound, and miscellaneous oils can be removed by a preliminary cleaning in a trichoroethylene vapor degreaser. If a degreaser is not available, inhibited alkaline cleaners are made especially for aluminum alloys. These are inhibited to prevent any rapid attack on the aluminum alloys.

It should be noted that the general metal cleaners available for use on steel, brass, or zinc should not be used due to the high alkalinity which will react vigorously on aluminum alloys.

The aluminum cleaners are used in concentrations of eight to 16 ounces per gallon in mild steel tanks. The solution level should be held four to six inches below the surface of the tank due to the foaming which is caused by the soaps in the cleaner. Temperatures of 160 to 212 F are used with better results being obtained in the higher temperature range. Automatic heat controls are not necessary due to the wide latitude of temperatures allowed.

The aluminum cleaner should be followed with a warm water rinse with an overflow dam along one side. Usually, suds will be carried into the rinse tank by the work. An effective means of removing the contamination on the surface of the water is the installation of a perforated pipe on the side of the tank opposite the overflow dam. One-eighth inch holes drilled at four to six inch intervals have proved very practical. In general, cold water rinses have proved ineffective due to the rapid solidification of the cleaner residues on the work while transferring it from the cleaner to the rinse.

Following the pre-clean and rinse, the next stage is an alkaline etch. At present, two basic etches are in use. A solution containing five per cent caustic soda (NaOH) and 4 percent sodium fluoride is used at temperatures of 140 to 180 F.

It is necessary to provide ventilation for the vapors. It is also necessary to use tanks lined with rubber or plastics to prevent the attack on the tank because of the fluoride ion concentration. With this etch, the attack on the base metal is very rapid and immersion times vary inversely with temperature. For example, 30 to 40 seconds at 140 F achieves the same degree of etching as 5 to 10 seconds at 170 F.

A much more convenient etch is the solution containing 5 percent to 10 percent caustic soda used at room temperature. Immersion time is dependent on the concentration of the caustic. Generally, 30 to 45 seconds in 10 percent caustic equals 1¼ to 2 minutes in 5 percent caustic.

The straight caustic etch requires little ventilation, may be used in mild steel tanks with no linings, and does not require heating elements or controls.

Both of the caustic etches leave a dark gray, blue, or black smut, depending on the alloy used. The castings should be rinsed in cold running water after etching. The smut must be removed by acid dipping. The most common acid dip is concentrated nitric acid used in stainless tanks, glass lined tanks, or in crockery. The nitric acid is exceedingly effective on such alloys as 85, 380, A380, and 384 which contain copper as a principal alloying element. Immersion time is 5 to 15 seconds. It is very easy for the plater to observe when the smut is completely removed.

When high silicon alloys such as 13, 360, A360, 380, or 384 are used, it may be necessary to modify the acid dip by the addition of hydrofluoric acid. The most common ratio is three parts of nitric acid to one part of hydrofluoric acid by volume. Rubber or plastic lined tanks are a necessity.

With the alloys containing magnesium as the principal alloying element, as in the alloy 218, it may be necessary to use two acid dips. The cleaning cycle would then be:

1. Vapor degrease or alkaline clean and rinse
2. Alkaline etch
3. Rinse
4. Sulfuric acid dip (20-25%) sulfuric acid at room temperature in lead lined tanks)
5. Rinse
6. Nitric acid dip
7. Rinse

Following the cleaning cycle, the work is given a zincate immersion treatment immediately. The zincate immersion is the most widely used treatment at the present time.

The primary function of the zincate treatment is to remove all traces of the oxide film and simultaneously deposit a very thin metallic film. The film is essentially pure zinc although some of the zincates deposit zinc and nickel simultaneously. Claims have been made that the nickel results in better adhesion and increased ductility of the plated deposits.

The most popular and easiest to control of the zincate treatments is the caustic zincate which contains 13 to 15 ounces of zinc oxide and 55 to 70 ounces of caustic soda per gallon of solution. The solution is used at room temperature in steel tanks. The solution should be made up in advance due to the heat evolved in the solution of the caustic. This will require cooling prior to using.

The immersion time varies from five to 60 seconds with 10 to 15 seconds being the most common. A steel-gray uniform coating should be obtained. The thinner the layer of zinc, the greater will be the adhesion of the subsequent coatings.

If a spotty layer of zinc is obtained, the work should be dipped in concentrated nitric acid for five to 15 seconds, rinsed, and re-immersed in the zincate for the desired time. In some installations, it is common practice to follow the double immersion as a standard procedure as it gives more consistent and uniform coating.

Continued on page 66

Bush Yoke Sander, wall mounted. The sander arm can be located at five alternative positions from horizontal to vertical.

The same machine, floor mounted. Available with or without the table shown. Belt change is a matter of seconds on this machine.

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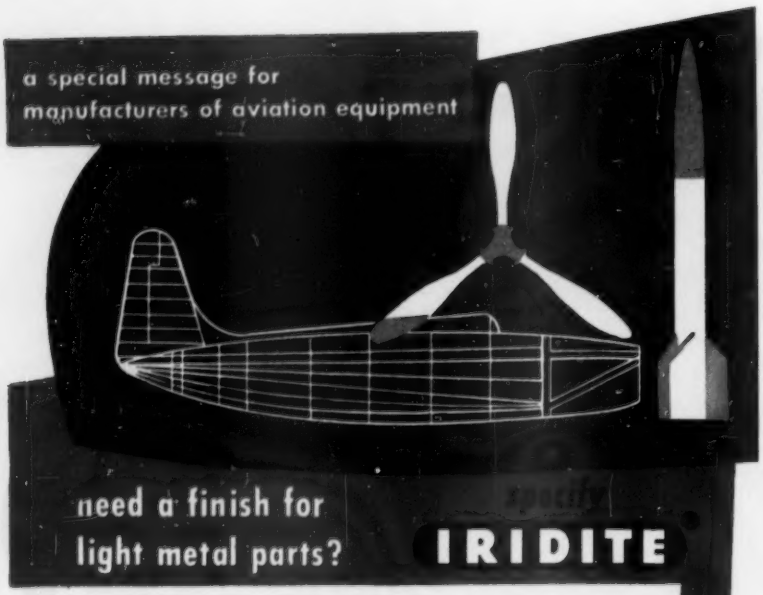

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Plating Aluminum—Cont.

Other zincate immersion treatments available are of an acid nature and contain nickel as an activator and as a deposited metal.

A fluoborate both can be made up zinc fluoborate (48% concentrate) 21 ounces per gallon, nickel fluoborate (44% concentrate) 23 ounces per gallon, sucrose or lactose, 2 grams per gallon, and water. The pH should be adjusted to a range of 3.0 to 4.5. Fluoboric acid is used to lower the pH; nickel carbonate to raise it. Operating temperature can be varied from 70° to 130° F with immersion times of 5 seconds to 10 minutes. In general, two to four minutes at room temperature or 30 to 45 seconds at 130° F have given good results.

An alternate fluoborate zincate is composed of zinc fluoborate (48% concentrate), 42 ounces per gallon, nickel fluoborate (44% concentrate) 1 ounce per gallon, ammonium chloride, three ounces per gallon. The original solution should be adjusted to a pH of 3.0 with nickel carbonate or fluoboric acid as described above. The operating range is pH 2.5 to 4.5 with the operating temperatures and immersion times as described in the previous fluoborate zincate.

Following the zincate treatment, the work is water rinsed and electroplated. Excellent results have been obtained by using a copper cyanide strike as an initial step in electro-plating. A typical composition is:

Copper cyanide 3 oz/gal
Sodium cyanide 4.5 oz/gal
Sodium hydroxide 0.25 oz/gal

The pH should be maintained at 9.5 to 10.5 in contrast to the 12.0 to 12.5 normally used in strikes. It may be necessary to add sodium carbonate to the bath to lower the pH to the desired range. Operating temperatures are 70 to 110F. Current flow is controlled by maintaining a constant voltage of 4 to 6 volts. The current must be on the work when it is immersed in the tank. Otherwise, the alka-

Continued on page 70

Product Facts

Catalogs · Manuals · Brochures

PROCESSES

The Die Casting Process: 144

A new and highly informative booklet on the design and application of die castings has been issued by the American Zinc Institute, Inc.

Designing for Investment Casting: 145

A 20-page booklet—"Investment Casting—Basic Design Factors for the Engineer" has been prepared by the Scott Casting & Mfg. Co.

Gray Iron Permanent Mold Castings: 147

A brochure giving the advantages and applications of permanent mold gray iron castings is being distributed by the Dostal Foundry & Machine Co.

Investment Casting: 148

How to reduce manufacturing costs through the use of investment castings, the properties of some castable ferrous and non-ferrous alloys and some design data are given in a new catalog from Casting Engineers, Inc.

Die Castings: 149

Design data, material selection factors, alloy compositions and properties are all given in a new booklet issued by Chicago White Metal Products, Inc.

MATERIALS AND EQUIPMENT

Interval Timer: 154

An electronic timer said to maintain accuracy of ±1% over a wide voltage variation is described in a brochure from Ferrara, Inc.

Metals Digest: 155

A new house publication "Federated Metals Digest" gives information on the many uses of castable metals prepared by the Federated Metals Div., American Smelting & Refining Co.

Shell Mold Machine: 156

A fully automatic machine for making up to six shells per minute is described in literature available from the Beardsley & Piper Div., Pettibone Mulliken Corp.

Induction Melting For Investment Casting: 157

A bulletin from Inductotherm Corp. describes a new induction melting unit suitable for investment casting, and said to incorporate many improved features.

Temperature Controller: 158

A temperature control instrument for control of fuel-fired process applications which require a true proportional relationship between fuel input and a continuously measured temperature is described by the Wheelco Instruments Div., Barber-Colman Co.

Casting Impregnation: 159

A new eight-page, two color brochure illustrating modern casting impregnation, is available from American Metaseal Mfg. Corp.

Soft Metal Patterns: 160

A revision of an earlier book, "Cerro Alloys in Foundry and Pattern Shop" has been issued by Cerro de Pasco Corp.

Die Casting: 161

The Lester Press, house organ of Lester-Phoenix, Inc. gives information on the uses, both old and new, of zinc and aluminum die castings, and tips on casting practice.

Self Lubricating Bearings: 162

A new stock list, giving over 600 standard sizes and types of porous, self-lubricating bushings has been published by Bound Brook Oil-Less Bearing Co.

Hardness Tester: 163

A new hardness tester has been introduced by Steel City Testing Machines, Inc. that incorporates three colored lights to indicate a range of Brinell hardness. As a go, no-go device the tester can be tied into a production line to give automatic hardness testing.

FINISHING

Self Tapping Screws: 168

A new line of self tapping screws being produced by the Set Screw & Mfg. Co. is fully described and available types and sizes listed in a bulletin just published.

Specialty Buffs: 169

Several new types of automatic buffs designed to meet special needs of buff users are featured in the new 12-page catalog now being distributed by American Buff Co.

Spray Booths: 170

A bulletin has been issued by Despatch Oven Co. describing the water wash spray booths designed and manufactured by the company.

To get copies of any item listed here, simply circle the appropriate number on Reader Service Card bound into this issue.

Continued on page 68

WHAT'S THE BEST WAY TO STRIP METAL PARTS IN LARGE VOLUME?

See page 9

Are you looking for better methods for stripping paint?

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¶ What's the best way to strip paint from metal parts too large to be soaked in tanks? *See page 3.*

¶ What's the best way to strip large areas of structural metal where a steam supply is available? *See page 5.* Where steam is not available? *See page 7.*

¶ What are the best ways to prepare stripped metal for repainting? *See page 11.*

¶ What strippers are best for removing oil-base paints? . . . Synthetic enamels, alkali-resistant plastics or resin-based paints? . . . Japans, wrinkle finishes, nitrocellulose lacquers, alkyds, phenolics and ureas? *See page 12.*

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PRODUCT FACTS

continued from page 67

Blast Cleaning: **171**
"Wheelabrator Tips" is a new publication of American Wheelabrator & Equipment Corp., aimed at new or better uses for airless blast cleaning equipment.

Barrel-Finishing: **172**
The Norton Co. has published a comprehensive report on barrel finishing with abrasive media. The 54-page booklet contains a great deal of basic information on methods.

Bright Nickel: **173**
A four page brochure from Platers Research Corp. describes a nickel bath additive for producing better bright nickel deposits.

Barrel Plating Equipment: **174**
The George A. Stutz Mfg. Co. has published a revised catalog on barrel plating equipment. Both continuous and portable equipment are described and illustrated.

Air Tools: **175**
In a 55-page catalog, The Rotor Tool Co. has described its complete line of air powered tools. Equipment for all types of jobs is described.

Air Motors: **176**
An all new 28-page bulletin has been issued by the Bellows Co. describing and illustrating their complete line of air motors and accessories. Charts and tables are given to aid in the selection of the proper unit for each job.

Bright Cadmium Plate: **177**
A new plating process specifically designed to meet the industrial demand for a direct bright cadmium plate has been developed. It is fully described in a technical bulletin P-131, available from the Frederick B. Stevens Co.

Rectifiers for Plating, Anodizing, Etc.: **190**
Helpful hints on installation of rectifiers for plating, anodizing, electrocleaning, etc., are contained in a new 8-page bulletin from Ther Electric & Machine Works. Featured are the company's many models of rectifiers.

Acid and Plating Hose: **191**
Descriptive data sheets and prices of a new line of hose designed to handle hot acids and all plating solutions is offered by Carl Buck & Associates. Stock sizes include 1", 1½", 2" and 2½" ID.

Vapor Degreasing Do's and Dont's: **192**
A manual showing proper degreasing methods has been issued by Manufacturers Processing Co. It treats the subject of vapor degreasing with brief text and many illustrations, including safety, personnel, layout and maintenance, drainage, machines, chemicals, etc.

HONITE Method Gives Better Finishes Faster

HONITE field engineer helps manufacturer save up to 50% on barrel finishing

Argus Cameras, Inc., Ann Arbor, Michigan, had been using barrel finishing since 1945—processing 175 different kinds of zinc, aluminum and steel camera parts such as those shown above. Last year HONITE Field Engineer D. J. Jones supervised a change to the HONITE Barrel Finishing Method.

Sample results? Recommended HONITE procedure helped cut finishing time on zinc die-cast levers from 36 hours to 15 hours—a time-saving of 58%.

Costs of deburring and polishing aluminum camera-case castings were reduced from $.118 per unit to $.059—with rejects cut from 54% by the old method to 7% with the HONITE method.

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PLATING ALUMINUM
continued from page 66

line solution will attack some areas of the aluminum with the resultant formation of a smut. Plating time in the strike bath is from 60 to 90 seconds.

Following the strike, the die castings can be plated with cyanide copper, acid copper, nickel, chromium, zinc, tin, cadmium, or practically any plateable metal depending on the end use.

Excellent adhesion has been obtained by nickel plating directly on the zincate treated aluminum. This is achieved in a Watts type bath of the following composition:

Nickel sulfate heptahydrate	32 oz per gal
Nickel chloride hexahydrate	9 oz per gal
Boric acid	6 oz per gal

No brighteners are used. Operating conditions are: pH 2 to 5, temperature, 140 to 160 F, and a current density of 40 to 60 amps per square foot. A small amount of hydrogen peroxide may be added to prevent pitting.

Bend tests on samples which were plated with nickel to a thickness of 0.0003 showed excellent adhesion. Heavier thicknesses showed lowered ductility until a maximum thickness of 0.0005 was reached. Beyond this point, ductility was reduced.

The nickel plate can subsequently be plated with other overlaying plates.

Alternate Methods of Surface Preparation

Several other methods have been used as a substitute for the zincate immersion treatment. One of the older methods is the use of a phosphoric acid anodize. The cleaning cycle is followed as above until the zincate treatment. Instead of immersing in the zincate, the work is anodized in a 55 to 60 percent phosphoric acid solution.

Many die casting alloys are processed more easily in a 20 to 25 percent solution. Temperature must be controlled closely from 80 to 90 F. This means that refrigeration must be provided. The work is treated for 5 to 15 minutes at 5 to 30 volts D.C. Racks and clamps should be of 2S aluminum as in conventional anodizing. The work is rinsed after anodized and plated in the copper strike.

Work can also be sulfuric acid anodized, rinsed, dipped in 0.5% hydrofluoric acid, rinsed, and plated in the copper strike.

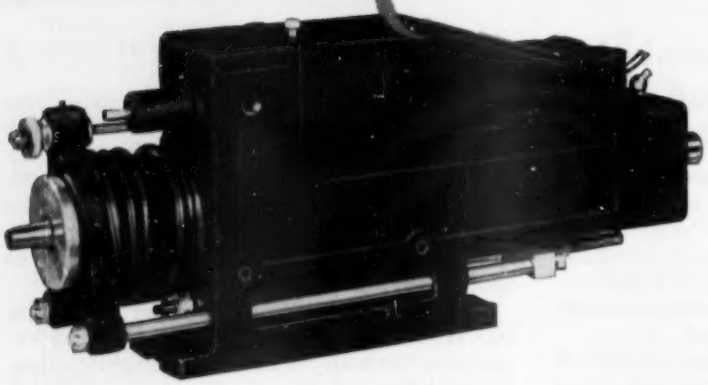
Both of the anodizing treatments result in a bond which is primarily mechanical, in which the plating is keyed in by filling in the pores of the anodized film.

Newly developed processes include a liquid blasting to remove the oxide from aluminum alloys and coat it with the media until it has been immersed in the plating media. This has been used primarily as a surface treatment prior to chromium plating. Another process involves a sprayed coat of rubber with electrical conducting properties which is followed by nickel plating.

It should be noted that some of the described processes are patented and may be used only under a licensing agreement. This article should not be misconstrued as permission to use these processes without such a licensing agreement.

Continued on page 91

Bellows-Locke
DRILL UNIT
Combines
HYDRAULIC FEED
•
AIR POWERED RAPID ADVANCE
•
ELECTRICALLY DRIVEN SPINDLE



Full 3" stroke — any part usable. Takes up to 5/16" drills. Either pulley driven or direct motor drive models available. Compact, streamlined, lightweight. Can be mounted at any angle in any plane. Any number of units can be easily synchronized and interlocked for accurately timed sequence operation.

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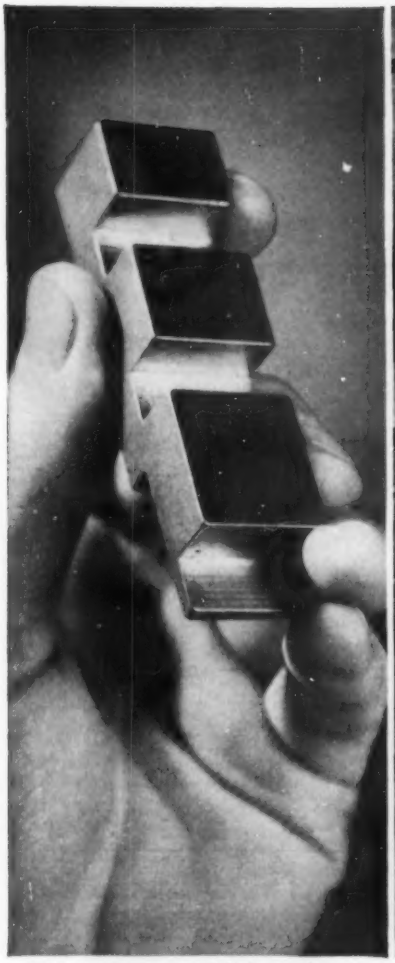
DEPT. PMM 1254

The Bellows Co.
AKRON 9, OHIO
In Canada:
Pneumatic Devices of Canada, Ltd., Toronto, Ontario

For more information circle No. 69 on the Reader Service Card



This part once cost 21½¢ per piece to finish. The manufacturer investigated barrel finishing and decided to give it a trial.

This method — barrel finishing — proved a sensational cost cutter. The medium is Norton ALUNDUM* Tumbling Abrasive. The cost per finished part today is 5½¢!

This abrasive, a typical Norton finishing development, is sharp, dense, hard and non-fracturing. Its blocky shape eliminates slivers and chips in the process.

Cost on this piece cut 75% with barrel finishing abrasive

"TOUCH of GOLD" *enjoyed as Norton ALUNDUM Tumbling Abrasive goes to work*

This finished part tells the story in a jiffy.

Once the work entailed "hand-deburring" at a cost of 21½¢ per piece. Now barrel finishing with Norton ALUNDUM abrasive does the job and the cost is 5½¢ per piece.

Besides the savings, these other advantages were also gained: *Uniformity of radii and surface . . . Brighter color . . . Smoother finish.*

Are you taking advantage of Norton ALUNDUM tumbling abrasive in your work?

See your Norton Distributor for further facts. Or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities, listed under "Grinding Wheels" in the yellow pages of your phone book. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass. G-280

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Making better products . . . to make your products better

NORTON

and its BEHR-MANNING *division*

NORTON: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING: Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes

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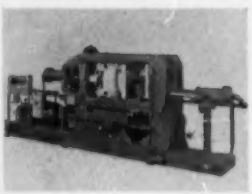
New Products ... the Reader Service Cards will bring full details



DIE CASTING MACHINE
. . . for 6 3/8 lbs. aluminum shot

Designed specifically to cast up to 6⅜ pounds of aluminum, or a proportionate amount of magnesium or brass, a new 400 ton die casting machine has been announced.

In the shot assembly the machine provides 21,000 psi maximum pressure on the metal. Both shot speed and pressure are adjustable, with an ASME approved nitrogen accumulator giving high speed injection. The water-cooled plunger tip prevents binding. Two fixed shot positions are provided.

The machine has a single piece alloy steel frame. Die opening is 12". The movable platen is 28" wide with 26" clearance between beams.

Various accessories are available for the machine to increase shot pressure to 32,000 psi.

Lester-Phoenix, Inc.
For more information, circle No. 199 on the Reader Service Card

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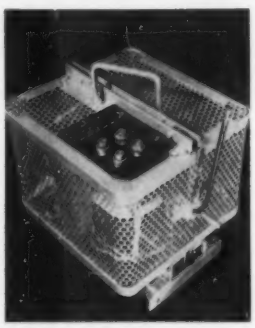
MAGNETIC PUMP
. . . to move liquid metals

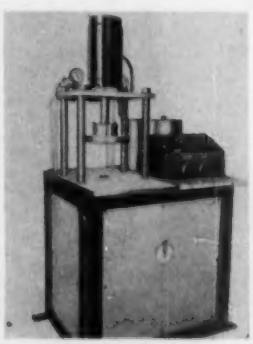
A new pump designed to move liquid metals within cooling or heating systems, for use in die casting operations and for general usage wherever liquid metals must be moved from point to point, has been introduced.

The new pump operates on an electromagnetic principle and has no moving parts or packing glands. It is designed for operation on single phase, 60 cycle current.

Conduction type EM pumps may be used to move any liquid metal which will wet the pumping section and which has a high conductivity. The pumps are normally tested at 1000F with a sodium-potassium alloy.

Callery Chemical Co.
For more information, circle No. 198 on the Reader Service Card





AUTOMATIC INJECTION PRESS
. . . for wax or plastic patterns

A completely automatic injection press designed for large volume production of accurate wax or plastic patterns for making investment castings, has been announced. It is said to be the first pattern-making unit that is fully automatic.

The cycle of the 3C Industrial Injector Model B, starts when the operator has positioned the mold over the injection nozzle. He flips a switch and the mold is clamped, material injected, and clamp released in one continuous operation. Indicator lights on control board show each phase of the cycle in operation. All phases can be individually operated if desired.

Tank capacity is 75 pounds, and a thermostat controls temperatures within 2 degrees over a range of 120 to 250 F. Refill of solid material can be made with-

Continued on next page

out interrupting production. Injection pressures up to 1500 psi are possible.

Features of the unit include: die clamping device automatically actuated by high pressure air cylinder, pressure gauges indicate precise pressure at all times, platen pressure pad jointed to the cylinder drive rod allows up to 15 degree tilt in any direction. Molds up to 14" x 8" of unlimited length can be accommodated. The entire work surface is ground to eliminate danger of mold distortion.

Centrifugal Casting Co.
For more information circle No. 197 on the Reader Service Card

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HEAVY DUTY RECTIFIER
. . . for plating and anodizing

The new Placo rectifier for plating and anodizing embodies positive down-draft cooling to keep the unit cool and free from dust, and has many special features including: oversize components, more-than-adequate stack size, foolproof on-load controls, full overload protection, oversize bus bar internal system and super-heavy duty transformers.

Units available from 25 to 6000 amps at 24 volts, are said to be constructed of highest quality materials and protected by heavy-duty cabinets.

Metal Finishing Mfg. Corp.
For more information, circle No. 202 on the Reader Service Card

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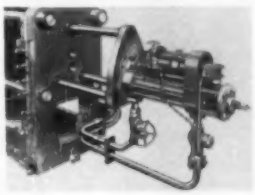
SHOT PRESSURE INTENSIFIER
. . . for die casting machines



A manufacturer of die casting machines has brought out, as optional equipment, a new shot pressure intensifier.

The new intensifier is engineered to operate without the use of time-consuming valves, permitting a simultaneous build-up from the normal line pressure to intensified pressure without hesitation, according to the manufacturer. Machines equipped with the new intensifier can multiply the line pressure to meet any requests specified by the customer.

The use of the new equipment, the maker says, results in denser castings, having a much finer grain structure with a better surface finish.

Cast Master, Inc.
For more information, circle No. 196 on the Reader Service Card

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PRESSURE SENSITIVE TAPE
. . . resists temperature change

A new pressure sensitive tape that is said to be highly resistant to many reactive chemicals and to drastic changes in temperature has been introduced.

The tape, made from polytetrafluoroethylene resin, combines all the properties of "Teflon" film with the chemical and heat resistant properties of a pressure sensitive silicone adhesive.

Minnesota Mining & Mfg. Co.
For more information, circle No. 204 on the Reader Service Card

Continued on page 74

For every grinding operation . . .

the **ONLY SINGLE SOURCE** *for the* **RIGHT ABRASIVE** *for* **EVERY JOB**

CARBORUNDUM

REGISTERED TRADE MARK

Niagara Falls, New York

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Setting the Record Straight:

Luster-on®

and

ITS IMITATORS

LUSTER-ON was the first bright conversion coating for zinc and cadmium on the market. Although it has been widely imitated, LUSTER-ON has *always* kept ahead of the field through continuous research and development.

LUSTER-ON has consistently offered greater uniformity of results — for less cost. LUSTER-ON has offered better control in use than imitative coatings.

When you specify LUSTER-ON you get not only the finest product of its type, but the added advantage of comprehensive Chemical Corporation service and teamwork.

Members of The Chemical Corporation team are working for you in our laboratories — testing, improving. Our technical specialists will roll up their sleeves and work with you in your plant, help solve problems on the spot. Our sales and distribution team is well integrated to supply you with materials when and where you want them. Our licencee manufacturers bring LUSTER-ON even closer to you — Crown Chemical and Engineering in Los Angeles and San Francisco for the West Coast; Alloycraft Ltd. in Montreal for Canada; A B Tudor, Harbeck Division of Partille, Sweden, for Scandanavia. And our own fleet of trucks speeds delivery to you.

When you deal with The Chemical Corporation you deal with a solid, well-financed company. You deal with a company built and growing on teamwork and service. You deal with a company vitally interested in its customers, doing that little bit "extra" that assures satisfaction.

LUSTER-ON — The first in the field and still the leader!

THE *Chemical* CORPORATION

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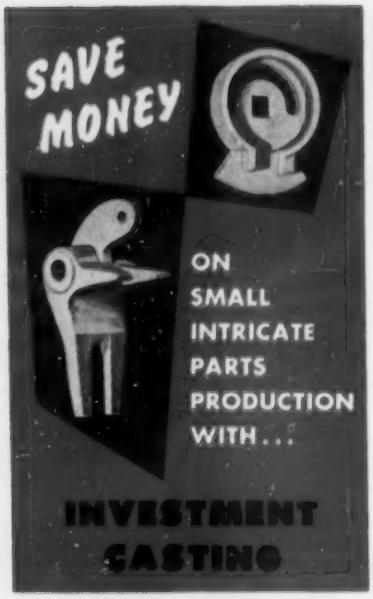

You'll eliminate costly machining operations and cut tooling and production costs with Investment Casting. This process is the economical way to –

- Cast intricate, undercut parts to critical dimensions and finishes.
- Cast parts where limited volume or high temperature of metal does not permit use of die-casting.
- Cast parts with shapes too intricate to forge.
- Cast metals that are too hard for economical machining or finishing.

We are in a position to offer you assistance in planning your own investment casting department – or, we will gladly recommend casting firms that can handle the operation for you. This service will not obligate you in any way.

WRITE TODAY FOR THE INVESTMENT CASTING STORY

This free 12-page booklet – "MODERN PRECISION INVESTMENT CASTING" – contains complete information on the Investment Casting Process.

ALEXANDER SAUNDERS & CO.
Precision Casting Equipment and Supplies
87 Bedford Street · New York 14, N. Y.
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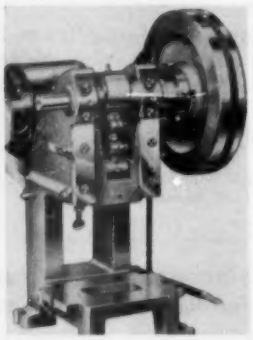
BENCH TYPE PRESS
. . . for small work



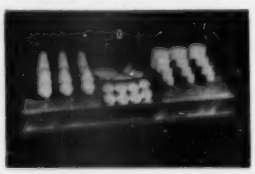
A 2-ton power bench type punch press has been introduced that has a rugged structure suited for trimming, production of small stampings, assembly or secondary operations.

The press can be used for operations such as cutting, riveting, blanking, and drawing on metals and non-metals. Through the use of this unit, heavier equipment can frequently be freed on small work or short runs.

Capacity of the press is 200 cycles per minute. It requires a ⅓ HP motor and has a direct V-belt drive and ¾" stroke.

Alva F. Allen
For more information, circle No. 201 on the Reader Service Card

FELT BOB ASSORTMENT
. . . in a package



A new assortment of felt bobs packaged in a box that doubles as a bench-top holder for the bobs when they are not in use, is now available.

The bobs in the assortment are mounted on ⅛" mandrels and include 12 plain shapes, consisting of four sizes each in soft, medium, hard and rock hard, and 16 standard shapes, also in four sizes each in four degrees of hardness. In addition, the assortment includes 36 wheels in assorted sizes and densities, a ⅛" mandrel on which the wheels may be mounted, and six 2" x 2" squares of rubbing felt for final hand finishing touch-ups.

Bacon Felt Co.
For more information, circle No. 203 on the Reader Service Card

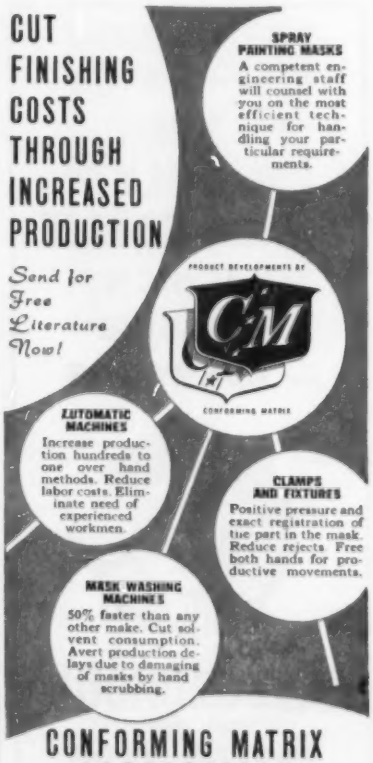
VACUUM PUMP ON WHEELS
. . . is complete unit

A vacuum pump unit on wheels that is reported to be the only movable vacuum pump unit available.

The unit is mounted in a metal cabinet on a heavy steel frame equipped with rubber tired ball bearing wheels. When in working position, the wheels are locked to prevent movement.

Only two connections are necessary, one to the equipment to be evacuated and the other to a source of electric power. The unit is only 3½ ft. high and requires 4 x 2½ ft. of floor space. The pumping unit is rated at 29½ inches vacuum at sea level.

Vacuum Forming Corp.
For more information, circle No. 205 on the Reader Service Card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SPRAY PAINTING MASKS
A competent engineering staff will counsel with you on the most efficient technique for handling your particular requirements.
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CONFORMING MATRIX
AUTOMATIC MACHINES
Increase production hundreds to one over hand methods. Reduce labor costs. Eliminate need of experienced workmen.
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Positive pressure and exact registration of the part in the mask. Reduce rejects. Free both hands for productive movements.
MASK WASHING MACHINES
50% faster than any other make. Cut solvent consumption. Avert production delays due to damaging of masks by hand scrubbing.

CONFORMING MATRIX CORPORATION
346 TOLEDO FACTORIES BLDG, TOLEDO 2, OHIO

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DIE CAST WHEEL

continued from page 49

welded together. The centrally located bearing is usually attached by pressing or staking.

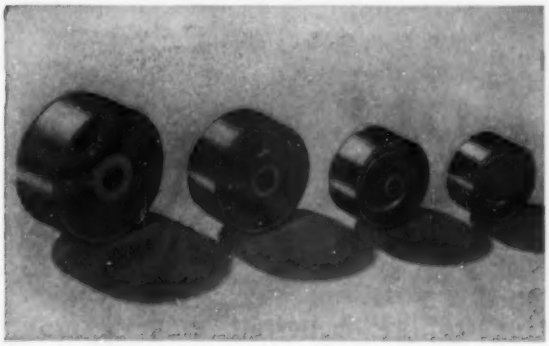
The die casting comes to the production line as a finished or semi-finished component, usually needing only to grind or polish the parting line, and ream or bore the hub. It is also possible to cast the bushing as an insert in the die casting, eliminating the need for removing taper from a cored hole and saving the operation of pressing in a bushing.

As a footnote, it should be pointed out that the development of a die cast wheel was not a simple matter, but is reported to be the result of cumulative research, engineering and tooling cost in the neighborhood of $60,000. Size range of wheels now produced include 10 inch and 12 inch diameters.

NEW PRODUCER OF ETHYL SILICATE

Anderson Laboratories, Inc., Weston, Mich., announce that their new modern ethyl silicate unit is now in production. The various grades of ethyl silicate are available in commercial quantities and warehoused for prompt shipment.

A company spokesman reports that a pilot plant unit has been in operation since last November.



Low-cost sintered metal wheels

Bassick's 10 years in powder metallurgy plus newly doubled plant capacity work together to give you sintered metal wheels and rollers (other intricate parts, too) for only 3¢ to 30¢ each, depending on size, quantity, and metal requirement. Equal to machined parts in mechanical strength, physical properties.

Write The Bassick Company, Powder Metal Division, Bridgeport 2, Conn., for Bulletin SM-54.

Bassick
A DIVISION OF
STEWART WARNER
MAKING MORE KINDS OF CASTERS... MAKING CASTERS DO MORE

75 YEARS OF CASTER LEADERSHIP

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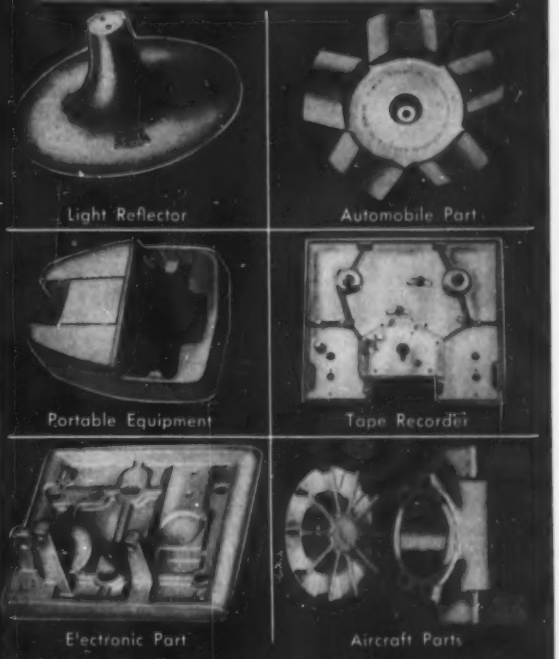
In the Electrical Manufacturing Industry

There Are Unlimited Applications for Die Casting Parts and Components from Aluminum and Magnesium



As shown in the illustrations above, parts for electrically operated equipment can be die cast from Aluminum and Magnesium in practically every shape and form. These new alloys not only greatly reduce weight but their toughness and mechanical strength are adequate for all demands placed upon them. Die Castings, such as these, offer greater scope to the designer, and to the manufacturer — important savings through the virtual elimination of machining, finishing and assembling.

Manufacturers throughout the country of products listed in the following fields, are successfully using Die Castings of Aluminum and Magnesium produced by LITEMETAL: Business Machines • Home Recorders • Electric Motors • Electronic Equipment • Portable Tools • Home Workshop Equipment • Home Appliances • Automotive Electrical Equipment • Projectors • Radio Television and Telephone Equipment • Aircraft Equipment • Farm Equipment • Marine Equipment.

Let's Talk It Over . . .

LITEMETAL DICAST, INC. is an organization of specialists — men thoroughly experienced in the casting and machining of magnesium and aluminum alloys. Our equipment includes big machines for big jobs — little machines for little jobs . . . the right sizes and types of the most modern die casting equipment for producing parts from the size of a button to large cable spools. Complete facilities for secondary operations are also available.

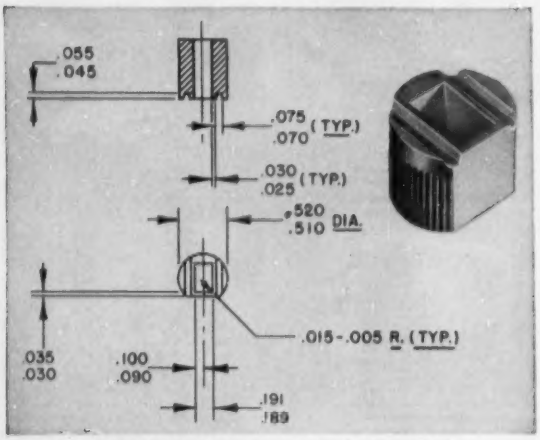
Write today for literature and design information. Quick action on inquiries.

LITEMETAL DICAST, Inc.
A DIVISION OF HAYES INDUSTRIES
1925 WILDWOOD AVE • JACKSON, MICHIGAN
PLANT AND EXECUTIVE OFFICES

For more information circle No. 41 on the Reader Service Card

BRASS SINTERINGS

End High Scrap Losses on Parts Like These



Fabricated by Kwikset Locks, Inc., Anaheim, Calif.

14 costly machining and finishing operations, resulting in a 35% scrap loss, are needed to produce this aircraft brush holder from brass bar stock.

Powder metallurgy eliminates the scrap, cuts piece costs 65%—and the dimensional accuracy is the same.

This cost saving is not unusual in small cylindrical shapes, because powder metallurgy provides these design features *without machining*:

- ***Surface indents or projections on tops or bottoms of parts***
- ***Simple flanges or projections at one end***
- ***Splines, gear teeth and knurling***
- ***Holes, counterbores, slots and keyways of many shapes***

You will be interested to know, too, that generally accepted commercial tolerances for brass sinterings are .004 in. per inch on radial dimensions, and .010-.015 in. per inch on axial dimensions.

How much you can save on these and other machine parts depends on how well you know powder metallurgy as a production method. That's why you should have a copy of our new 32-page manual, "FACTS ABOUT PRESSED BRASS and other nonferrous POWDER PARTS."

It will be sent to you without obligation by the manufacturers of Horse Head® brass and other nonferrous metal powders.

THE NEW JERSEY ZINC COMPANY
160 Front Street • New York 38, New York

For more information circle No. 51 on the Reader Service Card

SPECTROGRAPHERS TO MEET

The American Association of Spectrographers is planning its 6th Annual Conference in Chicago, Illinois May 6, 1955, on the subject "Industrial Applications of Spectroscopy".

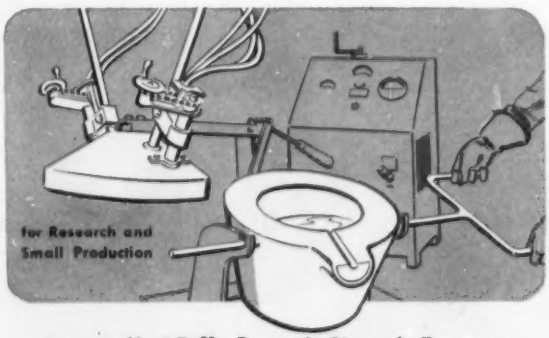
Contributed papers in the fields of emission, X-ray fluorescence, or absorption spectroscopy as applied to industry are invited.

Abstracts must be submitted by March 1, 1955. All inquiries should be addressed to: F. E. Stedman or E. E. Stilson, Co-Chairmen, Engineering Research Laboratory, Bendix Products Division, Bendix Aviation Corporation, 401 North Bendix Drive, South Bend 20, Indiana.

BONE EXPANDS PLANT FOR INVESTMENT CASTING

Since acquiring its investment casting department over a year ago, production at Bone Engineering Corp. has grown to the extent that increased facilities have been necessary.

Bone recently added 21,000 square feet adjacent to its main plant on West Broadway in Glendale, making a total of 50,000 square feet.



Versatile 15-lb. Detroit Electric Furnace

Compact 12 KW, 15-lb., Detroit Electric Furnace excels in a variety of research and small production jobs. Converging indirect arc electrodes in cover force arc down over metal for fast melting. Cover lifts and swings aside for easy charging and pouring. Pot can be transported as crucible or tilted to pour from stand. Insulated pot equipped with permanent lining or removable crucibles. Power unit and meters contained in one cabinet, require only simple wiring to electrodes.

Write today for complete information on Type PT Detroit Electric Furnace.

FEMA

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Foreign Representatives: in BRAZIL—Equipamentos Industrias, "Elsa" Ltd., Sao Paulo; CHILE, ARGENTINA, PERU and VENEZUELA: M. Castellvi Inc., 150 Broadway, New York 7, N. Y.; MEXICO: Cia Proveedora de Industrias, Atenas 32-13, Apartado 27A3, Mexico 6, D. F., Mexico; EUROPE, ENGLAND: Birlec, Ltd., Birmingham.

For more information circle No. 38 on the Reader Service Card

BOOK REVIEWS

continued from page 27

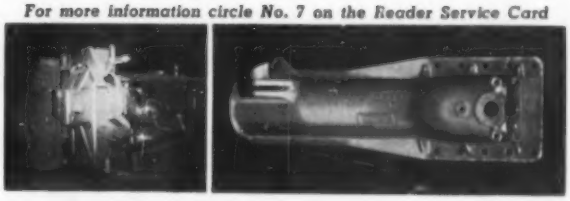
The author has attempted to answer some of the most frequently asked questions and problems he has encountered in 18 years of first-hand experience in working with plant people on cylinder design, selection and application.

The 21 chapters stick pretty close to the exact, detailed information that has proven most helpful. One chapter, "Cushion Limitations and Variations", is the most complete, practical treatment of cushions ever published. There are other chapters devoted to Ordering Information, Operating Speed, Shock, Mounting Clearances, Air Power-Oil Control. A final chapter has 12 capsule case histories of applications. The book is illustrated by nearly 250 sketches by the author.

A 10-page Appendix contains commonly used charts and tables, including specially prepared J. I. C. Hydraulic and Pneumatic component symbols.

The entire orientation of the book is toward practical, working solutions for the day-to-day problems met in planning hydraulic systems. It will be a valuable reference piece for engineers.

For more information circle No. 7 on the Reader Service Card



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Good design combined with well cast, economically produced aluminum permanent mold castings are the keys to volume sales and bigger profits . . . And our job here at Aluminum Permanent Mold is designing and producing better castings for outstanding manufacturers of American civilian and defense goods. Pictured above are a permanent mold oil pan die and casting and truck trailer leg bracket. For finer castings large or small call in an Aluminum Permanent Mold Engineer.

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IMS PURE SILICONE MOLD LUBRICANT

FOR CLEANEST DIE CASTINGS

- NON-SMOKING!
- No Carbonaceous Deposits
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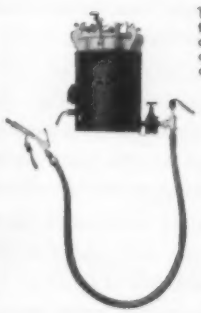

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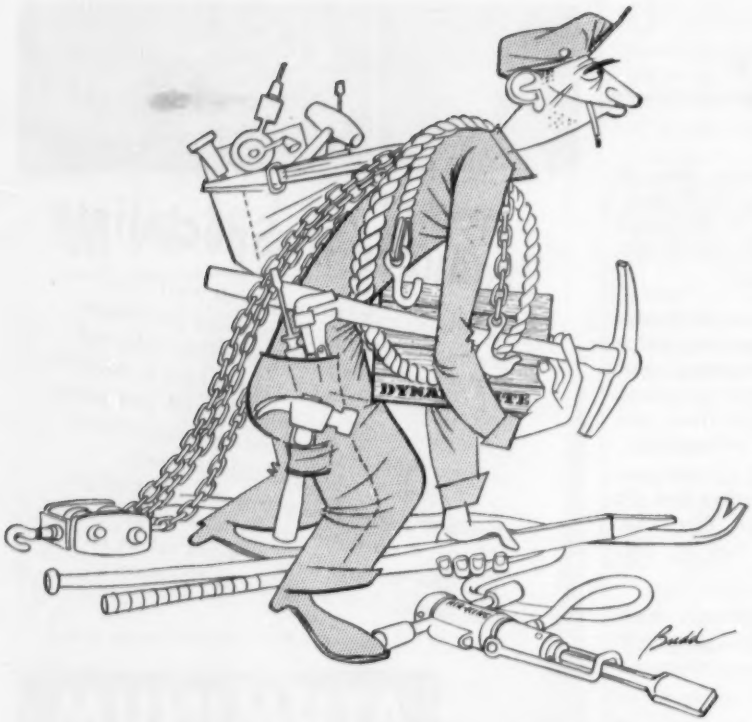
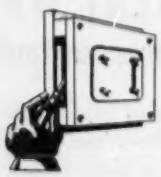


he's got everything but the ounce of prevention*

1. Dip blow pipe in Die Slick

2. Spray sparingly over die cavity face



3. Spray on ejector mechanism

Poor Hubert could put away his pounds of cure to remove stuck castings, if he'd only prevent them in the first place, with Die Slick.*

Die Slick puts an end to sticking, scoring, soldering, and other costly headaches caused by faulty die lubrication. It will not stain castings, assures good surface finish, often stops plating problems before they start.

Unlike home-made part-time lubricants, each of the five grades of Die Slick is uniform—standardized *to do its job all the time.* It's inexpensive, saves many times its cost. No wonder nearly four out of five die casters use it regularly.

We suggest you try—and prove—Die Slick on your most difficult job, on a no risk basis. Simply specify the quantity you desire and the type of alloy on which you will use it. If you're not fully satisfied, simply return the unpaid invoice.

start every job with

DIE SLICK

G. W. SMITH & SONS, INC., 5403 Kemp Road, Dayton 3, Ohio

* smith's

"ounces of prevention"

It takes more than one compound to answer all die casting requirements. Here is brief information on the different Die Slick grades. More detailed information will be sent upon request.

Aids parting and ejection on difficult aluminum and magnesium castings. Non-staining. Enables better metal flow and fill-out of castings.

Expressly for brass castings—sometimes used on aluminum and magnesium. Extra heavy-duty compound with some lubricating graphite. Retains lubricity under high heat.

For clean, "hardware" finish zinc castings, where finest plating results are required. Assures maintenance of clean cavities, cores, ejector pins, and guide pins.

General purpose compound for zinc castings. Generally stain-free unless applied too heavily. Prevents sticking and scoring.

Standard Grade Die Slick, general purpose compound for aluminum, magnesium, lead and zinc castings. A high viscosity amber fluid not readily burned off by the heat of the dies.

Plunger-Slick is an adherent viscous grease that will not melt under highest casting temperatures. Used on plungers and all sliding parts. Prevents scoring, sticking, or wear, on cold chamber machines.

If full detailed information would be helpful, also a chart of where Die Slick compounds are most used, write for your free copy of our "Die Slick Data File."

Cordially,

V. W. Smith

V. W. Smith

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Industry News

Companies · Plants · Associations

TWO PROMOTIONS GIVEN R. D. GUMBERT BY MERCAST AND ALLOY PRECISION

Double promotions have been received with the past month by Ronald D. Gumbert who has been elected president and member of the board of directors of Alloy Precision Castings Co. in Cleveland, and also vice president of the Mercast Corporation of New York.

Ronald D. Gumbert

Mr. Gumbert joined Alloy Precision, a licensee of the Mercast Corp., in 1952 as executive vice president, having served for 11 years as production superintendent of the Pittsburgh, Pa., plant of Armstrong Cork Co.

Alloy Precision operates two plants in the Cleveland area which produce precision investment castings by the Mercast frozen mercury pattern process for the electronic, aviation, automotive and other industries.

Mercast Corp. recently announced that it would build a new plant in La Verne, California. According to Admiral Alan G. Kirk, chairman of the board, this is one of several steps related to plans for major expansion of the Mercast process.

Foundry Problems Discussed By Investment Casting Institute

The second annual meeting of the Investment Casting Institute was held in Chicago November 3 and 4. During the two day session both a business meeting and a technical session were held.

At the business session the survey of the industry made by the Institute was discussed. This survey, which covers almost every phase of the industry's activity and production, shows what products are made for what industries, the size ranges of installations in terms of equipment, floor space, capital investment, etc. This survey is available only to members of the Institute.

The technical session was devoted to problems, mostly production, that are common to all investment foundries.

Manley W. Mallett of Battelle Memorial Institute described the effects of gases in metals, some methods of determining the amounts of dissolved gases, and methods of degassing. While most of his remarks were with particular attention to the investment casting industry, methods of analysis and methods of degassing that were discussed apply, of course, equally well to all foundry practices. In the discussion, problems of the individual foundries were brought up and discussed with curative methods for the troubles suggested by both the speaker and other members of the institute.

In the second technical paper, Hoy O. McIntire, also of Battelle Memorial Institute discussed the various investment materials that are most generally used, paying special attention to the use of di-ammoniam phosphate as the bonding agent for the silica types of investments.

Dr. Nicholas J. Grant, associate professor of metallurgy at Massachusetts Institute of Technology discussed the relationship between the properties of cast or machined test bars and the properties of the castings. Placement of separately cast test bars in the flask, when cast at

NEW ICI OFFICERS: l to r (front row) T. Operhall, Misco Precision Casting Co., president; V. S. Lazzara, Casting Engineers, Inc., vice president; Louis Brooks, Jelrus Precision Casting Co., director; K. M. Bartlett, Thompson Products, Inc., director; (back row) A. C. Williams, Crucible Steel Co. of America, director; K. W. Thompson, K. W. Thompson Tool Co., director; K. J. Yonker, director. Not shown is H. P. Dolan, secretary.

the same time as the production parts, was discussed and examples given of how the placement effects the test values.

With these papers and subsequent ones on "Flow Characteristics of Liquids Entering Transparent Molds" by Douglas McCullough of the General Motors Research Corp.; "Factors Related to Dimensional Control," by E. G. Chapman of Misco Precision Casting Co.; "Standard Test Procedures for the Industry," by B. W. Duncan, a panel discussion; and "Material Specifications for Investment Castings," a panel discussion lead by Charles Yaker, Dr. James Freeman, Richard Martini, and Roger Waindle discussion from the floor was extremely lively.

LESTER ENGINEERING BUYS PHOENIX MACHINE CO.

Lester Engineering Company, Cleveland, Ohio, designers of injection molding and die casting machinery, announces the purchase of a personal production source, the Phoenix Machine Company. The purpose of the purchase is to increase production and ultimately reduce the cost of the equipment through expanded facilities and improved production methods.

As a result of the purchase, engineering, production and sales are now integrated under the same management. Lester-Phoenix Incorporated, the sales agency for the company, will continue under the name as a wholly owned subsidiary.

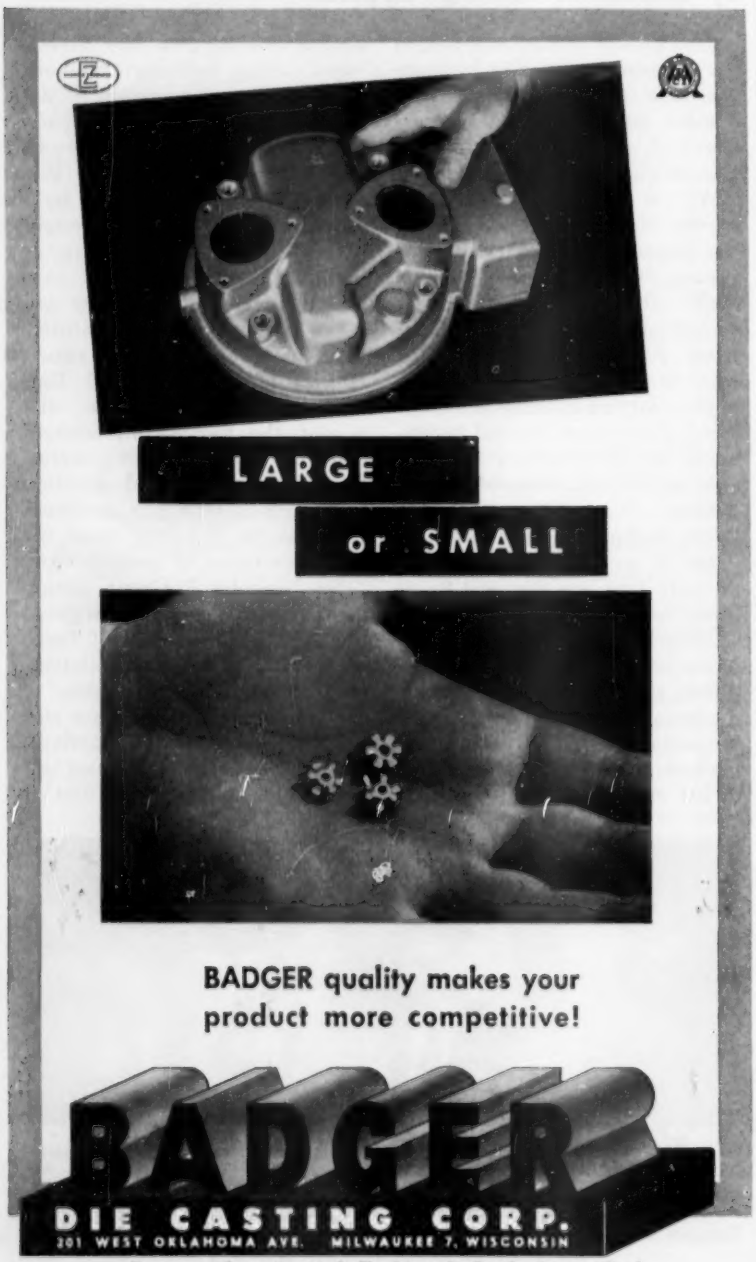
David White, president of Lester Engineering Co., also becomes president of Lester-Phoenix Inc. David J. Sloane is vice president of both companies. Henry A. Rocker is secretary and treasurer of both companies. William H. Schwartz, chief engineer for Lester Engineering, will now serve in that capacity for the combined companies. Present sales and service policies will continue unchanged.

G-E TO SELL TUNGSTEN, MOLYBDENUM

General Electric has announced plans to make its pure tungsten and molybdenum products generally available on the open market. These products in the past have been offered outside the company only to a limited extent.

The announcement was made by Herman L. Weiss, manager of the company's Cleveland Wire Works, who said he had appointed John W. Forbes to his organization to implement the plant's new sales policy. Forbes, formerly assistant manager of Cleveland Tungsten, Inc., will have responsibility for all marketing operations involving the plant's pure tungsten and molybdenum products. He will make his headquarters at the plant, at 1331 Chardon Road, Euclid, Ohio.

Tungsten and molybdenum are increasingly important to the national economy, according to Weiss. He predicted that efforts of scientists to "break through the temperature barrier" will open many new fields for these metals.



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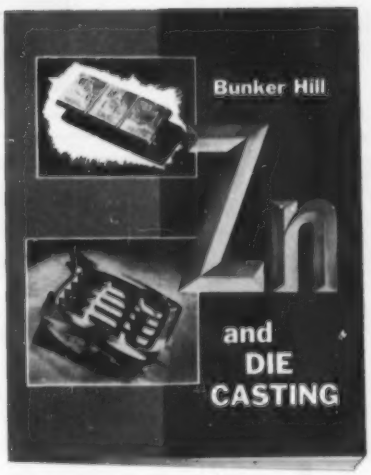
HERE is the story of.....



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OPPORTUNITIES

WANTED—Estimating Engineer—to work for a growing precision investment casting company in southern New Hampshire. Would prefer training in this field, but any casting experience would be considered. Modern plant and equipment. Engineering degree desirable. Age range to 35 years. Write giving experience, education, age and salary requirements. Write Box No. 11154, PRECISION METAL MOLDING magazine.

DIE CASTING PLANT MANAGER—For good sized die casting manufacturer in the East. Must have managerial experience in die casting production. To take charge of entire production organization: production departments, plant engineering production control, industrial engineering, etc. Good salary and profit sharing bonus. Will aid in relocating. Forward details of background and experience. Your reply will be kept confidential. Write Box No. 11254, PRECISION METAL MOLDING magazine.

INVESTMENT CASTING REPRESENTATIVES WANTED — Sales policy change leaves three major territories available. Applicants should now represent other casting processes. Full details in your first letter. Write Box No. 11354, PRECISION METAL MOLDING magazine.

POSITION WANTED — Die cast Superintendent desires change. 11 years with largest producer of refrigerator hardware. Experienced in die design, gating, machinery maintenance, etc. Will furnish references. Write Box No. 11454, PRECISION METAL MOLDING magazine.

DETROIT DIESEL
continued from page 40

grinding and thereby reduces costs.

Only changes in shape or size of the finished component consist of opening up the dimensions on the ID splines and the OD of the hubs. Neither of these changes affects serviceability of the part.

The fuel pump gear, Figure 3, is presently being tested for performance. Results, while still limited in scope, indicate negligible wear on the powdered iron parts.

On the machined fuel pump gear, all machining operations are expensive and time consuming; there are no machining operations on the powdered metal part, since all surfaces can be formed to close tolerances. Some opening of tolerances has been permitted on the pitch diameter and ID, but most dimensions are unchanged.

Saving in production cost is the most important factor in the proposed fabricating method change.

TITANIUM
continued from page 37

will materially reduce the required furnace cycle time.

Castings have been made in both pure titanium and titanium alloys. However, the size of castings produced in the past has been limited by the capacity of available laboratory equipment. The advent of the new skull furnace will permit castings of far greater size in quantity. These castings can find increased use in aircraft applications where titanium's unique properties of high strength-weight ratio and rupture strength in intermediate temperature ranges makes it a useful structural material. Its resistance to many extremely corrosive chemical media will make titanium castings of increasing importance to the chemical process industries in years to come.

*Note: National Research Corp. is prepared to grant nonexclusive licenses on its process, and to supply equipment and operating assistance to qualified foundries and to other logical licensees. Inquiries regarding the license agreement should be directed to: Development Department, National Research Corp., 70 Memorial Drive, Cambridge 42, Mass.

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To err is human . . . and also mighty expensive when you're dealing with dies, because design, drawing or pattern errors often add as much as 30% to final steel die costs.

You can prove out ideas with inexpensive, precision Plaster Mold Castings, which cost less to tool up for . . . and less to change.

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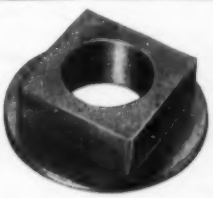

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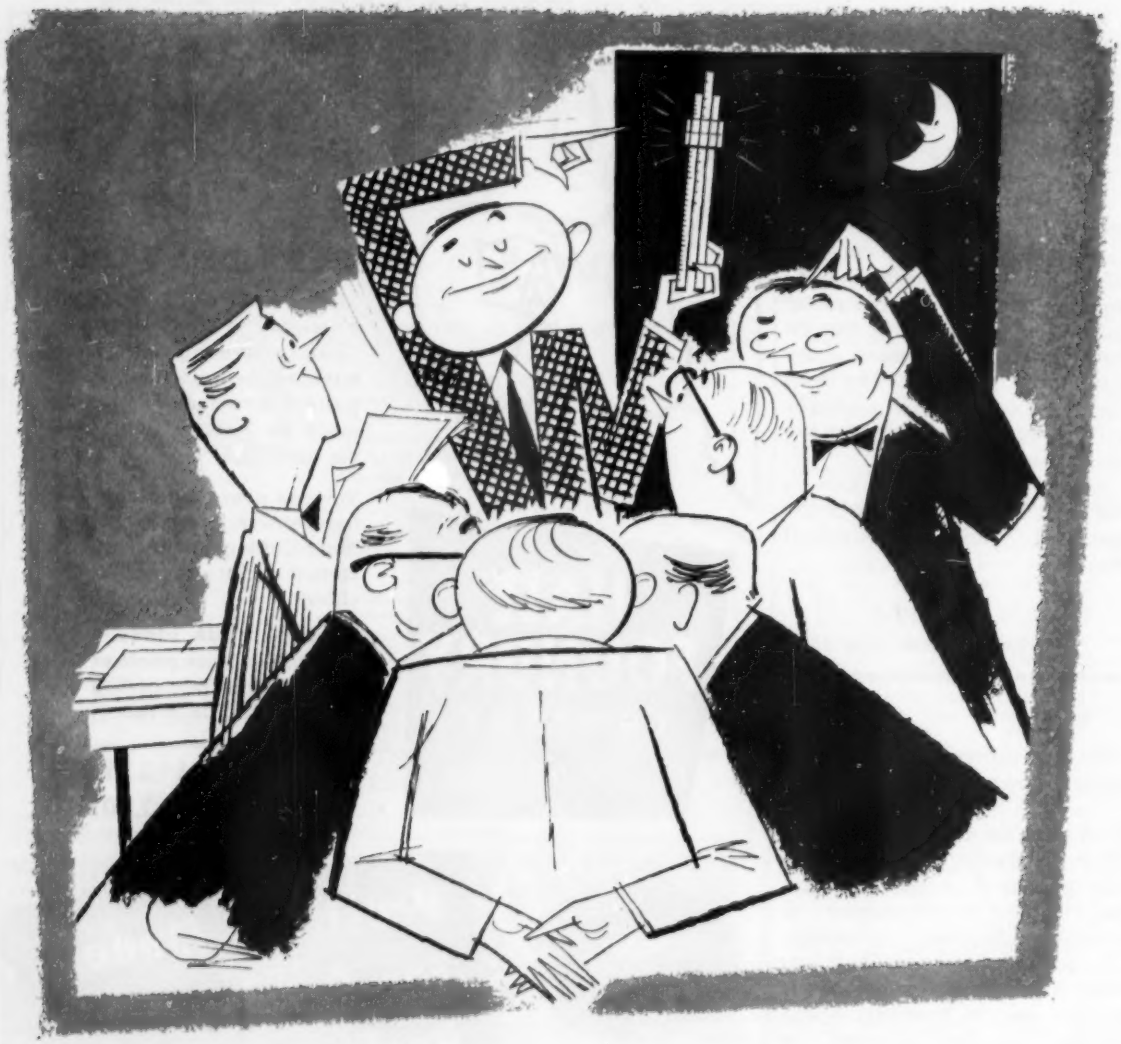

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Fire Resistant Hydraulic Fluids For Die Casting - Part 1, Aqueous-Base

W. H. MILLETT, Special Products Dept.
Carbide & Carbon Chemical Co.

HYDRAULIC FLUID SERIES

BECAUSE the use of fire resistant hydraulic fluids forms the basis for any safety program in the die casting industry, PMM is presenting here a series of papers on this vital subject. The first three are based on papers delivered before the American Die Casting Institute in 1954. The series will include:

1. Aqueous Base Fluids—Dec. 1954
2. Non-Aqueous Base Fluids—Jan. 1955
3. Commentary on Papers 1 and 2 —Feb. 1955
4. Reclamation of Fire Resistant Fluids—Mar. 1955
5. Packing and Gasket Material for Fire Resistant Fluids—Apr. 1955

DURING the past few years industrial users of hydraulic fluids have shown a rapidly growing interest in fluids with reduced flammability characteristics. This interest has been stimulated by two factors. The first of these is the recognition of the fact that greatly improved safety can be realized by the use of fire resistant hydraulic fluids, and the second is the development of improved less flammable fluids that can be used on a routine basis in industrial installations.

Such fluids are of particular interest to the die casting industry, since this industry undoubtedly represents the one with the most urgent need for such products. In fact, it is quite probable that all of the currently available fire resistant fluids were developed more or less specifically for the requirements of the die casting industry.

It is common practice to refer to fluids of reduced flammability as "nonflammable" hydraulic fluids. This use of the term nonflammable is actually incorrect, since practically all organic liquids can be made to burn under some conditions.

The important points to consider are that the fluids which are now being offered are much less flammable than conventional hydraulic oils and that they will not burn under the conditions normally encountered in die casting plants. It is for this reason that these products are more accurately called *"fire resistant", "less flammable", "safety", or "nonflammable-type"* hydraulic fluids.

Brief History of Aqueous, Fire Resistant Fluid Development

The concept of developing fire resistant hydraulic fluids around the well-known inertness of water was first reduced to practice on a substantial scale by the U. S. Navy in their search for less flammable aircraft hydraulic fluids. The original work on this problem was done at the Naval Research Laboratory with the cooperation of industry and has been thoroughly discussed in the technical literature[1,2].

The term "hydrolube" was coined by the Navy as being descriptive of fluid lubricants containing substantial quantities of water as a base. Thus "hydrolube" is a generic term rather than a trade name and can be correctly applied to any product of this type.

In 1946 a laboratory program was initiated that was directed towards the adaptation of the fluids developed for aircraft to the somewhat different requirements of industry. It was necessary to develop fluids with higher viscosity that could be used satisfactorily under the continuous operating conditions employed in a modern plant.

Such fluids would have to be rugged and would have to compete performance-wise with conventional petroleum hydraulic oils. In 1947, the first hydrolube-type, fire resistant hydraulic fluids were marketed to the die casting industry. Since that time their use in die casting machines has become well established and they have also spread to a host of other industries where the use of less flammable hydraulic fluids is a paramount safety consideration[3,4].

Properties of Aqueous Safety Fluids

Before aqueous, fire resistant fluids can be used successfully, the user must first be familiar in a general way with what they are and how they differ from the conventional hydraulic oils with which he is so intimately familiar.

These fluids consist essentially of from 35 to 60 percent water for nonflammability, a glycol, and a water soluble thickener to give body or viscosity to the fluid. In addition, the fluid will contain carefully selected additives that impart corrosion preventive properties as well as anti-wear and lubricity characteristics to the finished product. Thus, it can be seen that the final fluid is a carefully balanced formulation designed to meet the

CHARACTERISTICS AND PERFORMANCE DATA . . .

TABLE 1—Typical Viscosities Aqueous-Base Hydraulic Fluids

	Viscosity, SUS	
	100°F	0°F
FLUID A	201	3,300
FLUID B	306	5,500
FLUID C	554	11,000
MEDIUM GRADE PETROLEUM HYDRAULIC OIL	250	18,000

TABLE 2—Typical Rubber Swell Data For Aqueous Fire Resistant Hydraulic Fluid

Type of Rubber	Linear Swell, % (5 days at 158°F)
NATURAL	1.0
BUNA S	1.6
BUNA N	3.5
NEOPRENE	1.1—2.0
BUTYL	0.0—0.8
SILASTIC	0.0—2.0

TABLE 3—Vane Pump Test Data

TEST CONDITIONS:

Pressure	1,000 psi
Duration of Test	750 hours
Oil Temperature	150°F
Speed	1,200 rpm

FLUID TESTED	Petroleum	Aqueous Safety Fluid	
WEIGHT LOSS OF PUMP PARTS	Hydraulic Oil	Fluid A	Fluid B
VOLUMETRIC EFFICIENCY	0.91	0.39	1.79
% AT 1,000 PSI			
Initial	92	95	94
Final	84	98	94

Fire Resistant Fluid—Cont.

exacting requirements of modern industrial usage.

Certain properties and performance characteristics of these fluids are of particular interest to the industrial user. Those that are considered to be most pertinent are discussed in the following paragraphs:

1 Fire Resistance: The fire resistance of aqueous-base fluids depends on the water content, and they are considered to be essentially nonflammable as long as the water content is maintained. When the water is allowed to boil away or to evaporate by prolonged exposure to elevated temperatures, the residual fluid will burn when ignited. Experience indicates, however, that the major fire hazards in die casting plants involve ignition of sprays or mists of flammable fluids when lines break and packings or seals fail.

The resistance of the water-base fluids to burning has been evaluated by several methods including incendiary gunfire, spontaneous ignition, hot exhaust manifold, and spray flammability tests[5,6,7]. The spray flammability procedures have used hot and molten metal, electric sparks, burning gasoline and wood, and oxy-acetylene flames as potential fire sources.

All of these tests indicate that aqueous base fluids as formulated will not ignite under the same conditions that will invariably result in "flash" fires with petroleum hydraulic oils. In fact, it has been demonstrated that under certain conditions aqueous base hydraulic fluids of the hydrolube type will act effectively as fire extinguishing agents.

2 Viscosity: As mentioned previously, viscosity or body is imparted to aqueous fluids by the incorporation of a water soluble thickening agent. This means that the viscosity of the finished product can be varied by adjusting the quantity of the thickener in the finished formulation. Thus, it is possible to select a fluid having the proper viscosity for the mechanical equipment involved.

Representative viscosity characteristics are shown in Table 1 and are compared with typical viscosity values for a medium-grade petroleum hydraulic oil. A comparison of the low temperature viscosities of these fluids shows that the aqueous fluids have significantly lower viscosities at low temperatures than do conventional petroleum oils of comparable viscosity at 100 F.

3 Corrosion Protection: In view of the known corrosive characteristics of water, it is only natural that corrosion resistance would be a most important consideration for any water-base product. Careful attention has been directed towards this problem in the development of these fluids.

Both laboratory and extensive industrial experience during eight years of service have shown that the aqueous hydraulic fluids currently available commercially can be safely used in conjunction with the common materials of construction such as steel, aluminum, brass, or copper under normal operating conditions. Although fluids of this type cannot always be evaluated by conventional test procedures, it is of interest that water base hydraulic fluids successfully pass the standard ASTM test for rust preventive characteristics (ASTM Desig. 665-53T).

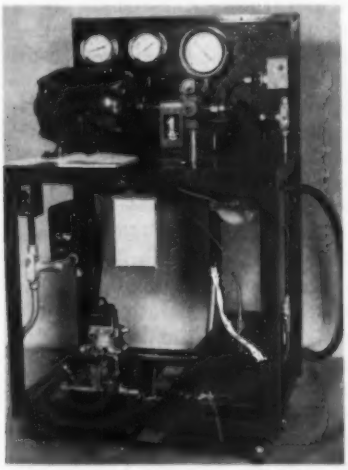
4 Effect on Seals and Packings: Aqueous-base fluids have generally shown no deleterious effect on the various sealing and packing materials encountered in the hydraulic systems of die casting machines. For this reason, no special seals or packings are required when converting equipment to the use of these products.

Table 2 presents rubber swell data for typical hydrolube-type fluids under standard test conditions. Based on these data as well as the experience that has been accumulated during the

past eight years, it is safe to assume that the use of the aqueous fluids does not present a seal problem.

One exception to this general statement is the use of cork impregnated seals. Although such products have been used successfully in die casting systems with water-base fluids, it is believed to be preferable to replace them with a more conventional rubber seal in view of the softening tendency that water exerts towards cork.

5 Wear Resistance and Fluid Delivery: An important point to consider before converting any system to aqueous hydraulic fluids is the suitability of the fluid for the particular hydraulic system involved. By far the greatest industrial experience with these fluids has been accumulated in hydraulic systems powered by vane type pumps.



1. THIS circulating hydraulic system was used for running tests, results of which are in Table 3.

Field service experience and laboratory test data combine to show that aqueous fluids can be used satisfactorily in such systems and that, with proper attention to hydraulic system maintenance, replacement of pump parts is not significantly higher than with standard petroleum oils.

Laboratory tests have been run in a circulating system such as shown in Figure 1. Tests were run for 750 hours at 1200 rpm and a pressure of 1000 psi. Fluid

Continued next page

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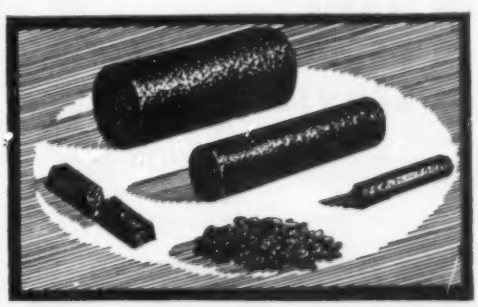

MasterMet alloys are available in ingot, shot, billet or short (6" dia.) cast bar forms and are normally shipped in drums. Specifications, weight, lot and customer's order number are clearly imprinted on container, making selection and storage a simple matter.

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temperatures were maintained at 150 F throughout the tests. Data presented in Table 3 give typical results as compared with those obtained using a high quality, widely used petroleum hydraulic oil.

Wear losses for all three fluids are considered to be acceptably low. It is also of interest that volumetric efficiency was maintained at a higher level with the aqueous fluids than with the conventional oil.

Experience in other types of pumps has been quite limited. In general, it can be stated that relatively low pressure systems appear to present no problem regardless of the type of pump used, but that high pressure systems may, in some instances, involve special considerations. Currently, considerable work is in progress to determine the suitability of various pump designs for aqueous base hydraulic fluids.

6 Solvent Effect on Paints: All of the currently available aqueous base fluids will soften or lift many of the conventional types of paints and coatings. This can be a serious problem if the fluid is installed in a hydraulic system without first checking for the presence of materials that might be affected.

It is, therefore, advisable to remove all paint from the inner surfaces of hydraulic equipment which may come in contact with the fluid unless it is definitely known that the paint will not be affected. There are a number of commercially available finishes which are resistant to this solvent action and which can be used satisfactorily with aqueous fluids.

7 Vapor Pressure: Because of their water content, aqueous base hydraulic fluids will be characterized by high vapor pressures at elevated operating temperatures. This may result in loss of water and, in some instances, loss of volatile inhibitors. For this reason, continued use of water base fluids at temperatures in excess of 150 F is not recommended.

This limitation is not a serious one since good hydraulic maintenance procedures dictate that hydraulic oil temperatures should not rise above this limit. Water loss has not been a problem in standard hydraulic systems. In general, these losses will range from as low as a few tenths of a percent per year for a relatively tight hydraulic system to as high as three to four percent for the same period of time if used without any adjustment.

Installation of Fire Resistant Fluids

The proper installation of aqueous base hydraulic fluids is probably the most important single consideration if they are to be used successfully[8]. The system should be cleaned as thoroughly as possible prior to installation of the fluid. Ideally, this includes draining all oil from sump, lines, and cylinders and, in addition, removing any sludge or deposits that may have accumulated during previous service.

For more information circle No. 52 on the Reader Service Card

It is realized that complete cleaning is not always feasible because of inaccessibility or mechanical limitations. In any case, as much oil as possible should be drained off and the system should be flushed and operated with a minimum quantity of the fluid that is to be used. The flush fill should be drained immediately after use so that suspended oil and sludge will be removed. The system should then be filled with fresh fluid.

During the early stages of operation, particular care should be paid to filters, since frequently the removal of sludge, oil residues and paint is incomplete. This can give rise to filter clogging and resultant pump starvation if filters are not watched carefully and the elements replaced as needed.

Undoubtedly, some petroleum oil will remain in the system. Small amounts of residual oil will not interfere with the performance of the aqueous fluids but they do detract from flame resistance. Accordingly, it is advisable to remove them insofar as it possible. Since petroleum oils are lighter than the aqueous fluids they will rise to the top of the sump and can be skimmed or siphoned off while the system is static.

To a large extent, the exact details of preparing a hydraulic system for fire resistant fluids will depend on the available facilities and on the mechanical set-up that is involved. If a series of machines are to be converted, the same flush fill can be used for several.

Steam cleaning has been found to be very effective where it can be easily utilized. The use of carbon tetrachloride or other chlorinated solvents should be avoided. Fuller's earth or activated clay type filters should not be used since they will tend to remove necessary additives from the fluid.

The procedures and precautions that have been mentioned may appear to be unduly laborious. Actually, all of the indicated steps are in strict accordance with recommended hydraulic oil practices. In summary, the important considerations are that the system be cleaned initially and that it be maintained as clean as possible. The best answer to the successful use of aqueous base hydraulic fluids has been good housekeeping and sound maintenance procedures.

Control of Aqueous Fluids During Use

For optimum results it is advisable to subject aqueous base hydraulic fluids to periodic control tests during use. Since the viscosity will increase if water evaporates from the fluid, viscosity is a convenient means of measuring the water content. Fluid suppliers will furnish charts or tables showing the amount of water to add for any given viscosity to restore the fluid to its original viscosity.

Only distilled, deionized or steam condensate water should be used for make-up, since hard water may cause inhibitor pre-

Continued next page

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For more information circle No. 81 on the Reader Service Card

cipitation. Normally, control tests are conducted at three or six month intervals. More frequent control is sometimes recommended for the first few months of operation.

Another control test that should be run on aqueous base hydraulic fluids is one that will give some measure of the level of corrosion inhibition or acid contamination. Suppliers differ slightly as to the recommended procedure but usually a periodic determination of either alkaline content of pH will be suggested. These determinations are relatively simple ones and can be made together with the viscosity measurements. Fluid control has not been a serious problem or limitation in using aqueous base hydraulic fluids.

Conclusions

In conclusion, it should again be emphasized that all of the various types of fire resistant fluids are radically different products than the petroleum oils for which there is such a tremendous background of experience. Not only do these fluids differ from conventional oils but they also differ just as radically among themselves. Accordingly, somewhat different standards will have to be used in judging or evaluating these products.

If it is agreed that improved safety is important, the biggest problem becomes that of recognizing that differences do exist between the various hydraulic fluids and then making an honest effort to determine what these differences are and how they affect performance.

It has been demonstrated that aqueous base hydraulic fluids can be used successfully in day-to-day plant operation. They are a realistic answer to a real industrial problem. The best way to succeed in their use is to know what they are, how they differ from conventional oils, and to follow sound hydraulic fluid maintenance practices.

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PLATING ALUMINUM
continued from page 70

Applications:

One of the prime reasons for electroplating aluminum is for the decorative appeal. Aluminum in the natural state or in the anodized condition lacks the high luster of a bright plate.

A typical use of electroplated aluminum die castings is the Bell and Howell Company's use of Alcoa 380 die castings as camera housings. These are plated with nickel and chromium. Areas are brushed to a satin finish to provide an eye-pleasing contrast to the bright chromium.

Manufacturers of fishing equipment, camera equipment, and spray guns have found the use of electroplated aluminum castings to have a greater appeal to the average buyer. In other applications, the automotive and aircraft industries have studied the advantage of plated aluminum die castings.

Brass plated aluminum die castings are being used as substitutes for such common household items window locks, door knobs, door stops, and hinges which have been made of solid brass or brass plated steel. The aluminum presents a pleasing appearance even after the plating has been worn off. In addition, there is no danger of rusting.

Another important use of electroplated aluminum is the obtaining of a hard surface on the castings. In general, the hard surfacing is hard chromium plated directly over aluninum or over an intermediate layer of nickel. Normally, an anodized surface would be sufficiently hard but for high wear resistance, a heavier layer of hard chromium gave longer life. In addition, the use of silicon alloys which are common in the diecasting industry causes difficulty in obtaining a suitable anodized surface.

These alloys plate readily with chromium, which provides a hard, porous oil retaining film which is excellent for friction and wearing characteristics. This application has been utilized for such items as pistons, small engine cylinders, pulleys, and aircraft gears.

Plated aluminum castings are often used where joining is a problem. The Ford Instrument Company has employed nickel plated aluminum to solve their sealing problem. The aircraft instruments which they manufacture must be sealed hermetically. They must also be capable of being opened and re-sealed.

Tin plate could not be used due to its tendency to ball up on the aluminum. Cadmium plate, although readily soldered, could not be opened and re-soldered due to the alloying of the cadmium with the lead-tin solder. Copper was suitable for soldering and re-soldering a limited number of times. It was then discovered that nickel plate was ideal from the standpoint of resolderability. A properly applied nickel plate 0.0005 thick could be re-soldered up to ten times without excessive breakdown of the plate.

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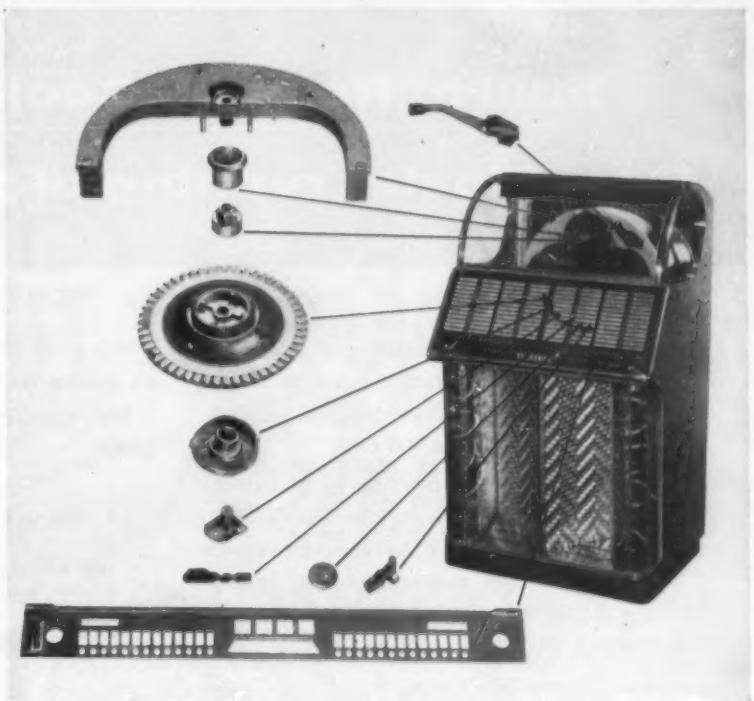

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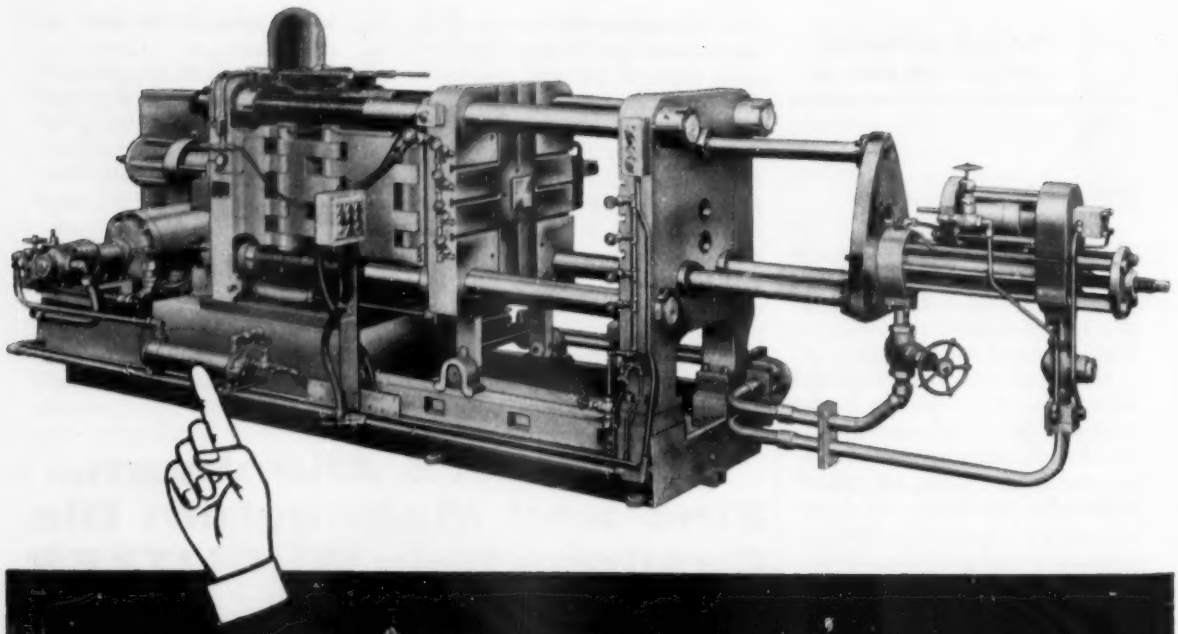

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For more information circle No. 37 on the Reader Service Card

Precision Metal Molding Editorial Index 1954

DIE CASTING

A

Aircraft structural parts can be die-cast ..... Apr. p 33
Aluminum die castings are larger ..... Sept. p 55

C

Cast-in steel inserts ..... June p 39
Cored slots plus pins cast as inserts give bayonet lock ..... Jan. p 36

D

Dentists buy improved performance and style ..... Jan. p 32
Design skill for a game of skill ..... Aug. p 35
Design trends influence die casting machine sales ..... Sept. p 60
Device for tapping beer kegs requires corrosion resistance ..... Oct. p 42
Die casting process, The ..... Dec. p 60
Die Castings in the garden ..... May p 37
Die castings save 33 percent over fabricated sheet ..... Sept. p 107

F

Ferrules . . . New use for die castings ..... July p 31
Final assembly in seconds ..... Dec. p 35
Fire resistant hydraulic fluids —Part I, Aqueous base ..... Dec. p 85
5,000,000 parts from a soft die ..... Feb. p 75
Flexible coupling designed to resist shock loads in shear ..... Nov. p 46

G

Get more for your money ..... Aug. p 37

H

Hand tool built with 10 die castings ..... Mar. p 44
Here's how aluminum die castings are welded in production ..... Jan. p 34
High tensile aluminum die casting in weld positioner ..... Mar. p 50
How many pounds of zinc die castings go into today's cars ..... Nov. p 39
How small design changes can improve plating quality ..... Sept. p 113
How to reduce zinc losses in die casting ..... May p 94

I

It couldn't be cast ..... Mar. p 41

L

Low cost gadgets for the kitchen ..... July p 47

M

Magnesium die castings enter the automotive field ..... Sept. p 58
Matched tolerances for press fit ..... Feb. p 40
Melting and casting pointers ..... Nov. p 96
More die castings for medics ..... Jan. p 31

N

New design features possible by welding castings to sheet ..... June p 42
New method to bond steel to aluminum ..... May p 49

P

Plumbing fittings by die casting ..... Apr. p 46
Plus values of die castings ..... Aug. p 55
Portable tools need precision in appearance ..... Feb. p 47
Positive register between hinged components ..... Nov. p 55

Q

Quiet . . . Die castings at work ..... June p 52

S

Savings right from the die ..... Aug. p 50
Shaping lead for structural applications ..... June p 46
Size limits for die casting extended by new machines ..... Sept. p 110
Steel insert gives spring to die cast hammer handle ..... Oct. p 49

T

These hoist designers get a lift from low cost zinc die castings ..... Jan. p 75
They come from the die already hinged ..... July p 40
They get durability with a zinc die casting ..... Sept. p 36
Three ways to use PMM processes ..... Apr. p 44
Tomorrow's die castings ..... Sept. p 62
Two different parts from one die cavity ..... Mar. p 51

Continued next page

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For more information circle No. 29 on the Reader Service Card

ANNUAL INDEX—Cont.

V

Vacuum die castings ..... Mar. p 91

W

Weight and dimension closely controlled in lead counterweight Apr. p 39
Where strength is needed, die castings can be used ..... Oct. p 35
Who will use tomorrow's die castings ..... Sept. p 51
Why a die cast housing ..... July p 36
Why a die cast wheel? ..... Dec. p 49

Y

You can use lead where precision dimensions and weight are needed ..... Jan. p 38
Your product can be simplified with a die cast housing ..... Feb. p 51

Z

Zinc die castings replace gray iron in railway equipment ..... Apr. p 36
Zinc, good supply, more uses .. Sept. p 52

FINISHING

A

Air operated fixture saves 60% in tapping zinc die castings .... June p 73
Automatic bulk flash removal on die castings ..... Aug. p 65

C

Company reports operating characteristics of new bright copper process ..... Jan. p 63
Complex die castings can be polished automatically ..... May p 59

F

Faster paint spraying with mechanized equipment ..... June p 67
15 ideas for using spring type fasteners to assemble die castings ..... July p 51
From die cavity to plated auto trim ..... Nov. p 59

H

Hot press ready to deliver 2 ton carbide ..... May p 62
How to make iron powder components resistant to rust and wear ..... Apr. p 103

M

Measure surface roughness .... Mar. p 63
Metallic sealing compounds can be used for production impregnation ..... Jan. p 59
Methods of plating aluminum die castings ..... Dec. p 63

N

New method of protecting magnesium, A ..... Aug. p 59
No polishing is required ..... Feb. p 54

P

Pick a screw that forms its own thread ..... Oct. p 63

S

Seal-protect-enhance with one coating ..... Dec. p 59
Silicone enamels ..... Sept. p 83

T

Thread damage can be prevented ..... July p 56
Three ways to use ultrasonic soldering on aluminum die castings. Nov. p 65
$22,500 saved in cleaning dies .. Mar. p 69
Two new ways to fasten shell mold halves ..... Apr. p 99
Two-operation boring ..... Sept. p 91

U

Ultrasonic cleaning ..... Mar. p 65

Y

You can group your rotary operations on a flash lathe ..... Oct. p 59
Your choice of felts for finishing metals ..... May p 65

INVESTMENT CASTINGS

B

Beryllium copper investment castings ..... Jan. p 33
Booking allows more design latitude ..... Jan. p 40

C

Cost cut 50 percent on small brush holder ..... June p 49

D

Difficult or impossible to machine ..... Apr. p 34

F

Five cylinder assemblies for the price of one ..... Feb. p 38
From machined bar to investment cast ..... May p 33

H

How much can we save on machining ..... Oct. p 40
How to save skilled instrument maker's time ..... July p 32
How weight reduction equals cost reduction ..... Dec. p 47

I

Influence of metal structure on properties of investment castings. Part I ..... Sept. p 122

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Influence of metal structure on properties of investment castings. Part II ..... Oct. p 92
Investment cast gears ..... Sept. p 73
Investment casting process, The .. Aug. p 38

O

Odd shapes can be easy shapes ..... Nov. p 53

P

Premium material at lower cost ..... Dec. p 40

S

Short run or long run ..... Mar. p 54

T

Three ways to use PMM processes ..... Apr. p 44
Titanium melting and casting ..... Dec. p 36
To reduce mass without sacrificing rigidity ..... Mar. p 38
Two ways to make pole pieces .. June p 44

W

Why the builders of textile machinery use investment castings .... Aug. p 54
Which beryllium copper alloy for your casting? ..... Nov. p 42

PERMANENT MOLD CASTINGS

B

Battery research improved lead castings ..... Sept. p 68
Brass permanent mold castings cost 16% less than sand castings .. Aug. p 48

C

Cast anodes for cathodic protection ..... Mar. p 48
Copper base continuous castings ..... Jan. p 44

D

Dense, pressure tight metal structure ..... Feb. p 33

E

Economical mold material for accurate casting of aluminum alloys ..... July p 81

H

Heavy machining calls for sound sections ..... Dec. p 45

I

Instrument redesigned for better visibility ..... Oct. p 37

P

Proper alloy choice reduces porosity ..... July p 38

S

Shaping lead for structural applications ..... June p 46

Y

You can use lead where precision dimensions and weight are needed ..... Jan. p 38

PLASTER MOLD CASTINGS

C

Castings in plaster molds pay off ..... Nov. p 44

M

Manganese bronze plaster mold castings give better performance Sept. p 80

P

Plaster mold casting process, The ..... June p 56
Preview your die castings, Here's an inexpensive way to ..... Feb. p 49

POWDER METALLURGY

B

Brazing: it's one of the users for infiltration of powder parts ..... Apr. p 57

How Twin City Die helped Donaldson cut pre-cleaner costs 33%

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For more information circle No. 62 on the Reader Service Card

C

Can powdered metal parts be finished? ..... Sept. p 77
Chuck jaws half price by powder metallurgy ..... Jan. p 48

D

Dependable, low cost powdered metal supply ..... Jan. p 37
Designing for self lubricating bearings ..... Apr. p 49

G

Greater freedom in designing contours ..... Mar. p 37

H

High properties powdered iron parts for motorcycles and bicycles Apr. p 40
High strength steel parts ..... Nov. p 48

I

Infiltration with copper ..... Dec. p 41

L

Low inertia flywheel using new materials ..... Jan. p 50

M

Metal powders for brake and clutch work surfaces ..... Apr. p 37

N

New directions in powder metallurgy ..... Aug. p 42

P

Physical properties of powdered brass parts ..... Aug. p 44
Piston rings of iron powder ..... Feb. p 35
Powder metallurgy ..... Oct. p 50
Powder metallurgy technique for high density, high strength parts ..... July p 42
Powdered iron cores of today ..... May p 52
Powdered iron rotating bands?, What about the Army's ..... May p 48
Precision parts sintered in gas-fired furnace ..... Mar. p 58
Progress report on powdered iron piston rings, A ..... Oct. p 38

R

Raw material in a "bag" ..... Dec. p 38

T

Ten facts to help you in buying friction materials ..... June p 55
Three ways to use PMM processes ..... Apri. p 44
Two heavy duty electrical contacts ..... July p 48
Two ways to make pole pieces ..... June p 44

SHELL MOLD CASTINGS

B

Big savings — 3 case histories of shell mold castings ..... Feb. p 44

F

Factors that affect choice of the proper casting method ..... Aug. p 93

H

High vibration calls for sound castings ..... Mar. p 57

R

Reduced machining allows tool write off in 50 castings ..... Jan. p 55

T

Take a good look at shell mold casting, Part I ..... May p 44
Take a good look at shell mold casting, Part II ..... June p 40
Take a good look at shell mold casting, Part III ..... July p 35

W

Where six castings saved $30 Sept. p 105

GENERAL

P

Patents, trade marks and copyrights ..... Oct. p 47

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Advertiser's Index

DECEMBER, 1954

A

Accurate Die Casting Co. 91
Acheson Colloids Co. 43
Acme Aluminum Foundry Co. 25
Advance Tool & Die Casting Co. 82
Ajax Engineering Co. 14
Allied Research Products, Inc. 66
Alloy Precision Castings Co. 17
Aluminum Permanent Mold Co. 77
Aluminum Smelters Research Institute 18
Aluminum Smelting & Refining Co. ..... Cover 2
American Smelting & Refining Co. 10
American Zinc Co. 24
Apex Smelting Co. ..... Cover 4
Auto-Diesel Piston Ring Co. 82

B

Badger Die Casting Corp. 80
Bassick Co., The 75
Behr-Manning Corp. 65
Bellows Co., The 70

C

Carbide & Carbon Chemicals Co. 6
Cannon-Muskegon Corp. 87
Carborundum Co. 73
Cast-Master, Inc. 1
Central Die Casting & Mfg. Co., Inc. 96
Central Screw Co. 62
Certified Alloys Co. ..... Cover 2
Chemical Corp. 73
Conforming Matrix Corp. 74
Crucible Steel Company of America .. 2
Cuyahoga Industries 97

D

Detroit Die Casting Co. 46
Detroit Electric Furnace Div., Kuhlman Electric Co. 76
Detroit Mold Engineering Co. 89
Dollin Corp. 8
Dostal Foundry & Machine Co. 23

G

General Metals Powder Co. 96
Glidden Company, The, Chemicals-Pigments-Metals Division 13
Gries Reproducer Corp. 94

Continued next page

Circle No. 56 on the Reader Service Card

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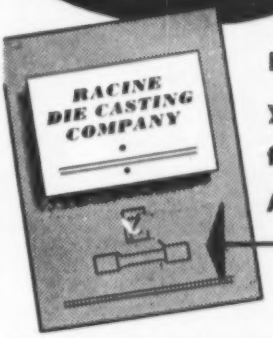

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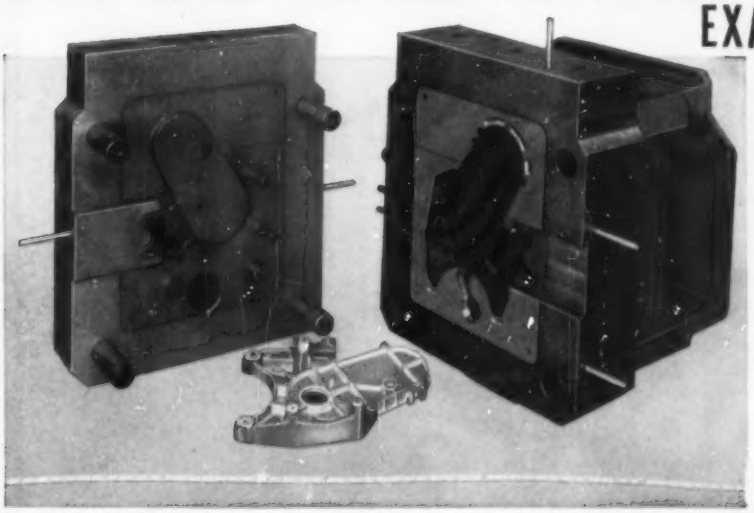

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For more information circle No. 20 on the Reader Service Card

INDEX OF ADVERTISERS

continued from page 97

H

Hale Foundry Co. 83
Henning Bros. & Smith, Inc. 93
Hoeganaes Sponge Iron Corp. 7
Hoover Co., The ..... Cover 3
Hydraulic Press Mfg. Co. 26

I

Injection Molders Supply Co. 77
International Minerals & Metals Corp. 98

J

A. Johnson & Co., Inc. 31

K

Kaiser Aluminum & Chemical Sales, Inc. 84
Kewanee-Ross Corp. 92
Kuhlman Electric Co. 76
Kux Machine Co. 48

L

Lake Erie Engineering Corp. 9
Lester-Phoenix, Inc. 20-21
Litemetal Dicast, Inc. 75

M

Martin Grinding & Machine Works ... 56
May-Fran Engineering, Inc. 44
Madison-Kipp Corp. 11
Metal Hydrides, Inc. 5
Milwaukee Die Casting Co. 32
Minnesota Mining & Mfg. Co. 69
Monsanto Chemical Corp., Organic Chemicals Division 4
Moraine Products Division, General Motors Corp. 22
Mt. Vernon Die Casting Corp. 15

N

Nelson Metal Products, Inc. 32
National Molded Products, Inc. 83
New England Die Casting Co. 34
New Jersey Zinc Co., The 76
Norton Co. 71

O

Oakite Products, Inc. 68

P

Paragon Die Casting Co. 88
Parker-Kalon Div., General American Transportation Corp. 58
Parker White-Metal Co. 29
Peco Machinery Sales, Ltd. 28
Precision Castings Co., Inc. 12
Projectile & Engineering Co., Ltd. 28

R

Racine Die Casting Co. 97
Republic Steel Corp. 33

S

St. Joseph Lead Co. 81
Alexander Saunders & Co. 74
G. W. Smith & Sons, Inc. 78
Sta-Warm Electric Co. 77
Stroh Die Moulded Castings Co. 30

T

Twin City Die Casting Co. 95

U

Universal Castings Corp. 27
Universal Die Casting Co. 90

Y

Yale & Towne Mfg. Co., Powdered Metal Products Division ... 19

Z

Z & H Mfg. Co. 30

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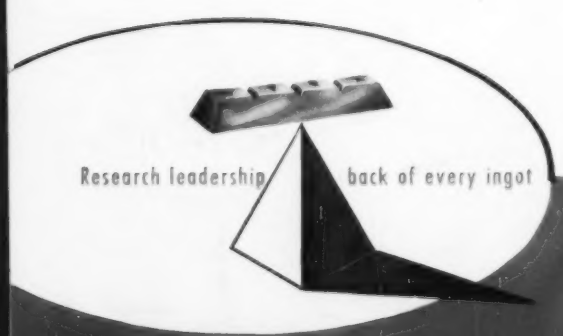

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